DEVELOPMENTS IN PLANT PROTECTION PRACTICES IN THE NURSERY INDUSTRY

ROSS M. LISLE

Plant Protection Department
Queensland Agricultural College
Lawes, Queensland 4343

INTRODUCTION

Plant protection is the management of insects, diseases, weeds, and other organisms which interfere with plant growth — and it experiences its own set of difficulties within the nursery industry. These embrace the high standard of cosmetic appearance demanded of the industry's products, the diversity of species cultivated and production environments utilized, and the need for workers to enter agrochemically-treated areas and handle treated plants daily. Other factors which complicate the day-to-day decision making associated with plant protection in plant nurseries include the lack of applied research information on the cultivar(s) and pests, and the interactions between the nursery environment and the pesticides used.

PESTS AND THEIR DEVELOPMENT

A pest is any living organism which interferes with the growth or cosmetic appearance of a plant. Thus, PEST is a collective term for organisms such as aphids, grubs, mites, fungi, weeds, mice, nematodes, and bacteria. The presence of pests in a nursery results in either reduced value of plants in the market place or increased production costs which are associated with producing a plant suitable for sale. The rate and scale of pest development and subsequently the damage inflicted are strongly related to the environment. The environments used by nurseries are diverse, ranging from rigid glass through poly-tunnels, shade cloths, and semi-protected to open environments, as well as computerized environment control houses. The rate of pest development, the population dynamics of the pest, and the level of damage incurred will all vary in the different environments. To manage pests adequately it is necessary to integrate a knowledge of the pest and cultivar and their environmental interactions as well as various control measures available, into a plant protection programme compatible with the management goals of the nursery.

FOUNDATION FOR PEST CONTROL

Next to a sound knowledge of the growth requirements of the cultivar(s) under production, hygiene is the foundation for pest control in nurseries. Whilst this fact has been recognized for years, the majority of nurseries pay limited attention to this practice. Greater attention to the many aspects of hygiene will be necessary for commercial survival. Prevention of pest problems is the cheapest form of control. Attention to the choice of pest-free propagating material, the storage and cleanliness of containers, cleanliness of media preparation and storage areas, media sterilization or pasteurization, the cleaning down of benches, beds, pathways before new stock is set in place, and the prevention of weed seeding in and around the nursery are some examples of hygienic practices.

More nurseries are increasing basic hygiene practices such as media sterilization and on-site chlorination of their water supply. From surveys conducted in Victoria by Sutton (7) and Curtis (2), the percentage of nurseries sterilizing or pasteurizing their media has increased from 32% in 1978 to 76% in 1984. Of the 76% of nurseries treating media, 33% used methyl bromide and 43% used heat treatments (Table 1), and while 38% have practised media treatment for more than 10 years, 28% have done so for 6 to 10 years and 10% for only 1 to 5 years.

Table 1. The proportion of nurseries, methods used, and the history of sterilization/pasteurization practices in the nurseries surveyed.*

DO sterilize/pasteurize			DO NOT sterilize/pasteurize
76%			24%
Methyl bromide	Steam	Air-steam	
33%	24%	19%	24%
History of treatment			
1-5 years	6-10 years	>10 years	
10%	28%	38%	24%

* Curtis (2).

CHEMICAL WELFARE — CHANGING STRATEGIES

Pesticides are widely used by nurserymen even though little information is available about their use for specific nursery cultivars, pests, or environments. Most nurseries have a vast array of chemicals which are badly stored and poorly applied — often with scant regard for the safety of the applicator or the nursery hands working in production. The choice of an appropriate pesticide, its strategy of use, pest resistance, timing, and type of application equipment needed, plus public health and environmental issues are some aspects which require consideration when developing a plant protection programme.

(a) **Improvements in New Pesticides:** Over the years since synthetic agrochemicals have been available there have been great improvements in the rate of application and selectivity, and knowledge of the potential for environmental distribution and accumulation and potential residue situations (3).

The rate of application of pesticides has steadily declined from the 1.5 kg per hectare for DDT in 1950 to the 100 g per hectare and even 20 g per hectare with the recent introductions of synthetic pyrethroids (Figure 1).

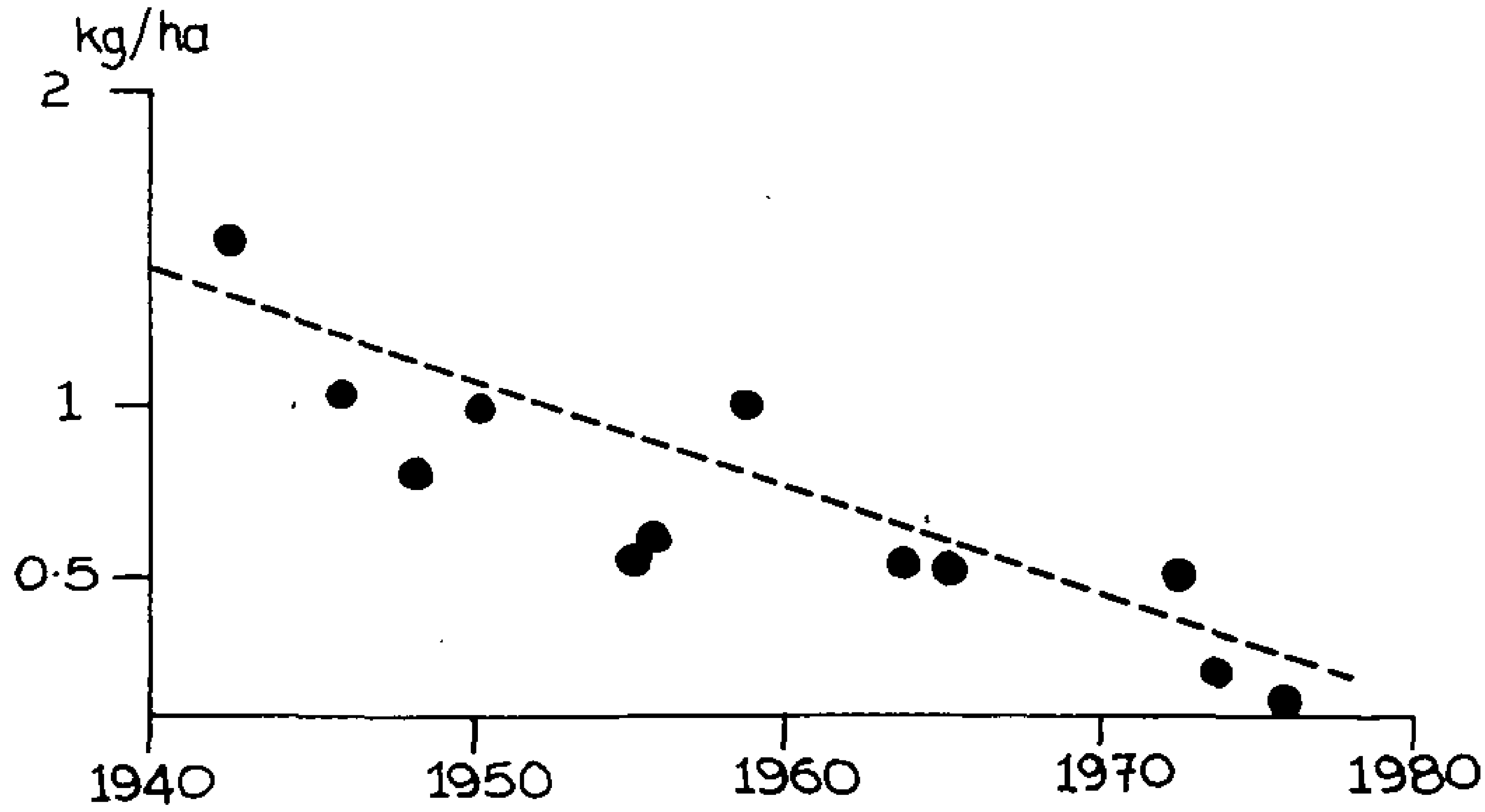

Figure 1. Evolution of rate of application of insecticides. Graph based on DDT (1942), parathion (1946), dieldrin (1948), diazinon (1951), azinphos-methyl (1955), dimethoate (1956), carbaryl (1958), chlordimeform (1963), monocrotophos (1965), diflubenzuron (1972), permethrin (1973), decamethrin (1975).

The potential of a chemical to be distributed and accumulated in the environment is determined by a number of physiochemical factors. The volatility and the ability of living organisms to gain access to and to accumulate it increases this potential. This potential is reduced by lower rates of application, by the more rapid degradation of the compound, and by its ability to be adsorbed onto soil particles. Water solubility may increase or decrease dispersal, depending on conditions. Figure 2 presents the above properties for a number of major insecticides. The decline of dispersal potential is demonstrated by a reduction of bar size and a shift of the bars towards the bottom half of the graph.

(b) **Application of Pesticides:** The pesticides available to the nurseryman have become more specific and selective in their activity. This in turn has demanded improved application techniques and the correct timing of chemical applications in relation to the stage of cultivar growth and pest activity if adequate pest control is to be achieved. Regular maintenance of equipment, operation of equipment in accordance with manufacturer's recommendations, and regular calibration of equipment are all necessary to ensure that the correct dose rate reaches the target.

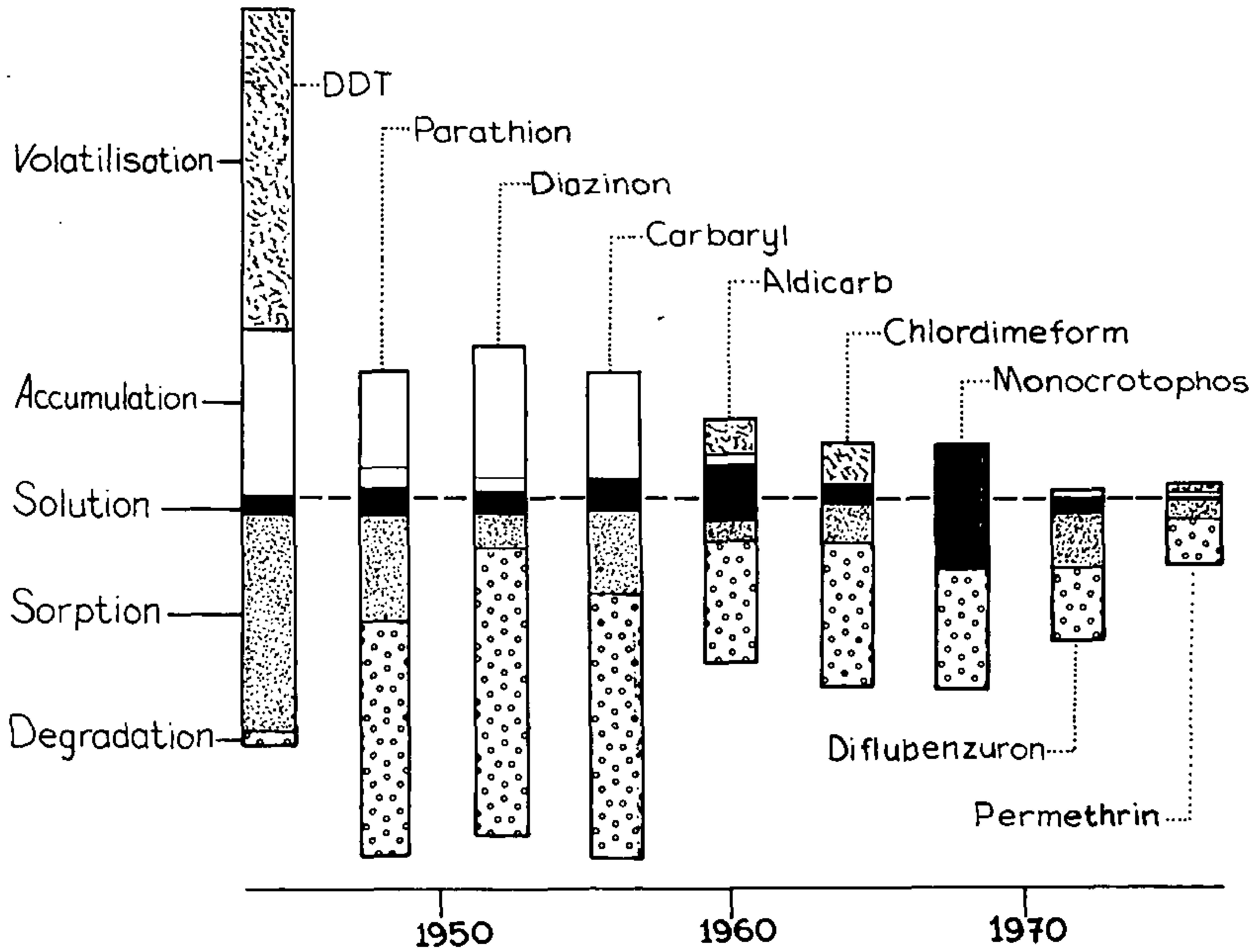

Figure 2. Evolution of the potential of insecticides to be distributed and cumulated in the environment. Compounds arranged according to time of introduction. The potential of a pesticide to be distributed and cumulated in the environment is reduced by a decreased rate of application (indicated by bar size), by the degradability of the pesticide and by its ability to be adsorbed on soil particles (sorption). Water solubility (solution) has a neutral position; it increases dispersal or degradation, depending on conditions. Thus the potential of the insecticides to be distributed and cumulated in the environment diminishes with decreasing size of the composite bars and with a shift of the bars toward the bottom half of the graph (3).

(c) Strategy of Chemical Usage: Strategies of use must aim to minimize the pressure on pests to develop resistance and to prolong the useful life of the pesticide. Better strategic use of such pesticides as the fungicides benomyl (Benlate) and metalaxyl (Ridomil) and the synthetic pyrethroid insecticides would have delayed the development of pest resistance to these useful and very active chemicals.

Major efforts must be directed at developing strategies to prevent or delay the build up of resistance, and such strategies must be implemented early in the commercial life of the chemical (6). Similarly, Bonar (1) has shown that nursery pests can develop resistance to pesticides very quickly, particularly under glass and with an over-dependence on chemicals for their control.

(d) Anti-Pesticide Pressure Group: Nurseries are industries in urban areas and draw their staff from such areas. In general terms urban societies do not favour the use of agricultural chemicals. The recent warehouse fires in Brisbane, Gatton, and Melbourne — all containing some agricultural chemicals — have only hardened the attitude of the anti-chemical groups. The community has the right to be concerned and demand protection from the indiscriminate use and sometimes blatant misuse of hazardous chemicals. The nursery industry does not have a clean record in this regard.

The real concern is that unless the hazard record of the manufacture, storage, distribution, and use of agrochemicals is improved then political pressure will result in restrictive legislation. This will mean fewer pesticides and greater restrictions on their availability and use. The anti-chemical lobby is well organized and has greater political clout than the nursery industry and farming associations.

There is support among research personnel to see the availability of the more hazardous pesticides restricted, and perhaps for some form of licensing of people at the point of recommendation, sale, and application.

(e) Alternatives to Synthetic Pesticides: Alternatives which appear to have the greatest potential in the short term are products based on insect diseases such as *Bacillus thuringiensis* (DIPEL), nuclear polyhedrosis virus (ELCAR) and, in the United Kingdom, *Verticillium lecanii* (a disease of aphids). Researchers are working towards more virulent strains and a broader spectrum of insect activity as a result of genetic manipulation (4).

Insect pheremones are finding use both in mating confusion and population monitoring in cotton budworm and pink bollworm, codling moth of apples, and the carnation tortrix, a nursery pest in the United Kingdom (8). The use of pheremones and insect diseases increases the complexity of plant protection programmes and broadens the control measures available in the nurseryman.

(f) Biological Control: This technique utilizes a beneficial organism to control pests by predation or parasitism. A limited range of beneficial organisms are available in Australia for use by the nursery, citrus, deciduous fruit, and vegetable industries.

The predatory mite, *Phytoseiulus persimilis*, has afforded control of outbreaks of two-spotted mite in nurseries, and parasites for mealy bug control should be available in late 1985. The nursery production system with its diversity of cultivars should favour the development and maintenance of a plant protection programme integrating pesticides compatible with the biological components. Nurserymen must learn how to manage such an integration without any reduction in cosmetic quality of the cultivars produced.

(g) Pest Monitoring: This involves the regular monitoring of susceptible cultivars for the presence, numbers, and stages of pests and beneficial species. These counts are related to the stage of growth of the crop, the environmental conditions, the life cycles of the pests and beneficial insects, and the nearness of the market. Pesticides are only chosen for a specific need and applications are only made when pest pressures demand treatment.

Monitoring techniques which take into account specific nursery pests and cultivars will need to be developed to continue to meet the cosmetic demands on the industry's products. Any resultant reduction in the number of sprays and release of labor for more productive activities can mean the difference between a profit or loss on a particular commodity.

PLANT PROTECTION PROGRAMMES

The development of plant protection programmes will be based on sound growing conditions for the cultivar(s) and the broad principles of hygiene. They will incorporate the use of biological control with the application of compatible pesticides based on the monitoring of pest and beneficial populations. The success of an integrated plant protection programme is dependent upon regular monitoring and the strategic application of compatible pesticides. Some extracts from such a programme for the integrated control of pests on ayr chrysanthemums in the United Kingdom are presented in Table 2 (5).

Table 2. Extracts from action sheet used in conjunction with weekly monitoring data of integrated pest control programme for ayr chrysanthemums for cutting.

Weeks after planting out	Pests to be observed	Pest threshold requiring action	Action if threshold exceeded
1	Leaf miner spots or miners	More than 5% plants affected	Diazinon spray
	Aphids in growing points	1 aphid per 2 plants	Spray of pirimicarb, nicotine or pyrethrum resmethrin
3	Thrips in growing points	1 adult per 50 plants	Spray nicotine
	Thrips in growing points	1 adult per 50 plants	Spray nicotine

Table 2. Continued

5	White and healthy aphids (check beneath leaves)	Any live aphid	Give second spray of *V. lecanii* to isolated patches if rest of bed showing white bodies, otherwise spray nicotine
	Thrips in growing points	1 adult per 50 plants 1 adult per 10 plants	Spray nicotine Spray diazinon
	Leaf miner Get parasitism checked by ADAS	If less than 95% parasitism and more than 5% plants attacked	Introduce 10 parasites 1,000 plants or spray diazinon
	Caterpillar holes or tatters in leaves	Any damage	Spray *B. thuringiensis* this week in preference to next
7	White and healthy aphids (beware immigrations)	Any live aphid	Spray pirimicarb for shiny brown aphid, nicotine for other aphids, diazinon if thrips present
	Thrips in buds	Any live thrips	Spray diazinon
	Leaf miner spots or mines	As for 5th week	As for 5th week
	Caterpillars	Any increase in damage	Fog *B. thuringiensis* and include the disease with all future *V. lecanii* sprays
	Red spider mite and predator	1 to 5 mites per infested leaf	There should be 1 predator every 5th infested leaf, purchase extra predator if there is a presence but below threshold

To operate a plant protection programme based on pest monitoring, a biological component and compatible agrichemicals will require special technical input.

YES! A major chance in pest control in the nursery industry will be a move to the integration of control practices plus the employment of professionals — people qualified in pest biology and population dynamics, agricultural chemicals and pesticide application, who also have an understanding of public health and the environmental constraints on pest control. You will contract this professional to monitor pest and beneficial insect activity at frequent intervals depending on the season, the pest, and the stage of growth of the cultivar(s).

NO! You will not lose control of your operation. You will receive a written report containing details of pest and beneficial insect populations, predicted changes in the populations, current level of damage, advice on compatible pesticides, and recommendations of what, when, where and how to spray. The decision is still yours.

The plant protection consultant will work closely with the manager or owner and will develop and fine-tune techniques for the monitoring of populations and damage and the provision of advice on the timing and placement of chemical applications. Consultants will not have your knowledge of the cultural requirements of your cultivars but will add detailed knowledge on your pests, co-operate in developing techniques, warnings, and advice to your benefit.

CONCLUSIONS

The last ten years have seen rapid change in the nursery industry — the development of large retail garden centres, the development of new propagation and production techniques, and a more intensive and sophisticated level of production and management. Experienced marketers are employed and export markets are being sought. To keep pace with the changing management and the demands of new markets the nursery industry need to upgrade its approach to pest control and reduce its dependence on regular scheduled applications of pesticides by the adoption of integrated plant protection programs and the employment of professional plant protectionists.

LITERATURE CITED

1. Bonar. 1984. Put away the spray. *Gardners' Chron. Hort. Trade Jour.* 195:6:24.

2. Curtis, C., 1984. The utilization of treated (sterilized/pasteurized) media in the container-plant industries of the Melbourne district. Research Project Series. November 1984. AGDEX 200/22.

3. Geissbühler, H., 1979, Reflections on future research and development in crop protection. *Proc. IX Inter. Cong. Plant Protect.*
4. Payne, C. and P. Jarret, 1984, Harnessing genes for pest control. *Proc. British Crop Protect. Conf. Brighton*, 1984.
5. Phillips, S., 1983, All very natural — a look at one chrysanthemum grower's successful efforts to use integrated control. *Gardeners' Chron. Hort. Trade Jour.* 193:11:21-23.
6. Staub, T., and D. Sozzi, 1983, The development of resistance in fungicides. *Proc. Inter. Cong. Plant Protect.* 1983.
7. Sutton, J., 1978, A survey of the nursery industry in Victoria. *Research Proj. Ser. No.* 3. June 1978. AGDEX 280/14.
8. Vernon, J.D.R. and O.T. Jones, 1983, Tortrix sprays need timing. *Grower* 99:13:31.

THE ROD TALLIS MEMORIAL AWARD

This award was set up in memory of the late Rod Tallis, a young Sydney nurseryman who had been very active in IPPS.

The award is offered each year to persons under 25 in the State where the Conference is being held. Young people in nurseries, educational institutions, and government departments, who have an interest in plant propagation, are invited to apply.

The applicants, who need not be members of IPPS must outline why they should be given the chance to attend the IPPS Conference. They also need to present a biography and to outline their interest in horticulture and plant propagation.

The winner of the award attends the Conference as a guest of the Society and must prepare a paper for presentation at the Conference. The winner also receives a book award.

In 1985 Peter J. Lewis, a recent graduate in horticulture from the Queensland Agricultural College won this year's award and presented the following paper:

THE POTENTIAL FOR GRAFTING IN THE PROPAGATION OF AUSTRALIAN NATIVES

PETER J. LEWIS

37 Sorbiston Street,
Wellers Hill, Brisbane
Queensland 4121

INTRODUCTION

Australia is the custodian of an amazing diversity of native plants. This diversity is linked with the widely varying