Current Status of Insecticide Resistance in Twospotted Mite from N.S.W. Cotton.

G.A. Herron, V.E. Edge, L.J. Wilson* & J. Rophail

NSW Agriculture, BCRI, PMB 10, Rydalmere 2116, Australia and

*CSIRO Cotton Research Unit, PO Box 59, Narrabri 2390, Australia

Introduction

Worldwide there are more than 33 species of spider mite known to infest cotton (Leigh 1985). However, in Australia only three species have been recorded in cotton. These are two spotted mite *Tetranychus urticae*, bean spider mite *T. ludeni* and banana spider mite *T. lambi*. Of these, only twospotted mite is a serious pest of cotton, mainly because of its ability to develop resistance to miticides.

During the 1970s and 1980s organophosphates (OPs), particularly monocrotophos (first tested 1969-70, registered 1972-73) and profenofos (first tested 1973-74, registered 1978-79), were the mainstay of mite control for the Australian cotton industry until propargite (first tested 1989-90, registered 1993-94) was released. Control problems with monocrotophos were reported as early as 1976 and NSW Agriculture has carried out a resistance monitoring program at Rydalmere since then. The results of those investigations are reported in this paper.

Materials and methods

A susceptible reference stain of twospotted mite was collected from an unsprayed source in Sydney. Field stains were collected from cotton in the Macquarie, Namoi and Gwydir valleys of N.S.W. and laboratory cultures established. Mites were cultured on potted French bean plants and maintained under insecticide-free conditions, in separate rearing units, at 28°C, and under constant illumination.

Mites were tested for resistance to proprietary formulations of profenofos (Curacron®), monocrotophos (Nuvacron®), dicofol (Kelthane®) and propargite (Comite®). Resistance was measured using methods described by Edge and James (1982). Briefly this entailed transferring 20-25 young adult female mites to 30 mm bean leaf discs. Mites on the leaf disc were then sprayed with insecticide using a Potter spray tower producing a deposit of 1.6 mg cm^{-2}. For each test mites were sprayed with a range of insecticide concentrations and a water only sprayed control. Sprayed leaf discs were maintained on moistened cotton wool for 48 hours after which mortality was assessed. Resistance factors were calculated by dividing the LC_{50} (concentration of insecticide to kill 50% of the sample) of the field strain by the LC_{50} of the insecticide susceptible strain.

Results and discussion

From 1978 to 1987 profenofos resistance remained relatively stable, at about 15-fold, but rose sharply in 1988 (Figure 1). A similar pattern was recorded with monocrotophos from 1976 until 1988, with monocrotophos resistance remaining around 40-fold. Monocrotophos resistance rose one year later than profenofos and resistance levels remained high for longer.

Profenofos has generally been preferred to monocrotophos since its introduction. Increases in monocrotophos resistance would have been caused by selection with profenofos as both are OPs. Resistance to monocrotophos increased significantly from 1989 with maximum resistance levels approaching 200-fold from 1990-1992. Ultimately the highest level of resistance to profenofos was considerably lower at <60-fold.

The levels of profenofos resistance were lower than monocrotophos

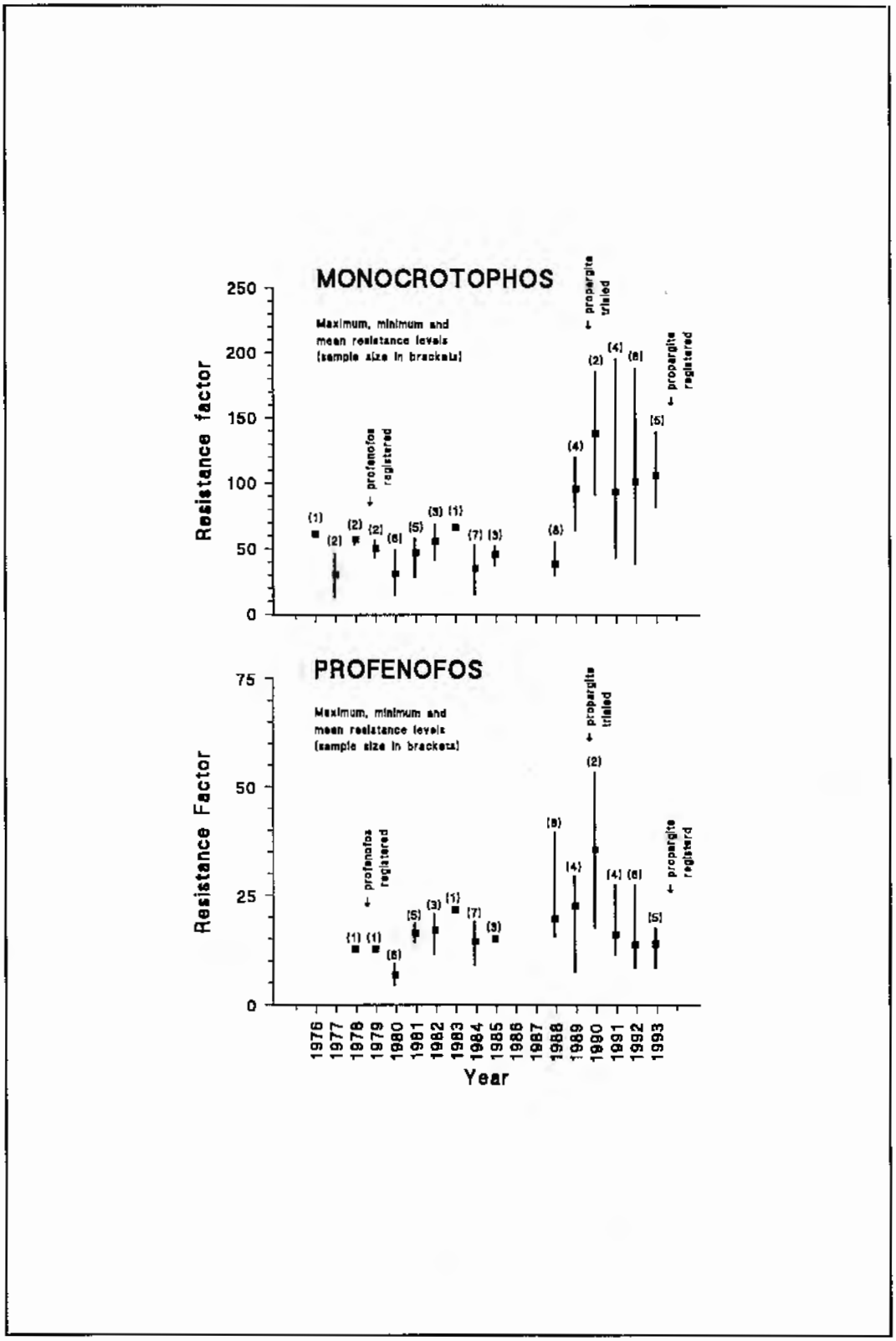

Figure 1 Monocrotophos and profenofos resistance in strains of twospotted mite from N.S.W. cotton.

but it was still difficult to obtain effective control with this chemical from the late nineteen eighties. Profenofos resistance did not exceed 25-fold before 1986, but by 1990 the highest level recorded was almost 60-fold. The net effect of this was to change a moderately effective chemical into a product that gave only marginal control of the more resistant strains.

The ovicide chlordimeform was withdrawn in 1986. Chlordimeform use suppressed mite populations early in the season, restricting the potential for severe early mite outbreaks. The withdrawal of chlordimeform resulted in an upsurge in profenofos use. This coincided with a marked increase in resistance (figure 1). Conversely the introduction of propargite resulted in less profenofos use and resistance to profenofos has declined.

Propargite is now the most widely used miticide in cotton, but resistance has not been detected to date (Table 1). That is

Table 1. Responses of strains of two spotted mite from cotton to dicofol and propargite compared to a susceptible reference strain (S)

Chemical	Year	LC_{50}[1] value for Susc. strain	range of LC_{50}[1] values for field strains	Number of strains tested
Dicofol	1991	32	29-44	4
	1992		23-39	6
	1993		25-33	5
propargite	1991	25	20-23	4
	1992		14-21	6
	1993	14[2]	15-19	5

[1] mg/L ai sprayed

[2] Formulation changed from Omite® to Comite®

evident from the similarity in LC_{50} values between the susceptible and field collected strains. There is also no evidence of resistance to dicofol which is only used occasionally in cotton. Other chemicals such as aldicarb (Temik^{n}) and one or two pyrethroids are active against mites and we are expanding our testing program to include those products.

Resistance monitoring has been restricted to NSW because problems due to mites are less frequent in Queensland and consequently miticide use is lower than in NSW. Generally, levels of OP-resistance in twospotted mite were highest in the Macquarie Valley.

At present the Australian cotton industry is heavily dependent on propargite to provide effective control. It must be emphasised that over use of propargite will undoubtedly lead to the development of resistance, as it has done with this product in other crops, particularly ornamentals (Herron, unpubl. data).

References

Abbott, W.S. (1925) A method for computing the effectiveness of an insecticide. Journal of Economic Entomology, **18**: 265-267.

Finney, D.G. (1971) Probit Analysis. 2nd Edition. University Press, Cambridge.

Edge, V.E. and James, D.G. (1982) Detection of cyhexatin resistance in twospotted mite, Tetranychus urticae Koch (Acarina: Tetranychidae) in Australia. Journal of the Australian Entomological Society, **21**: 198.

Leigh, T.F. (1985) Cotton. In: (Helle, W. and Sabelis, M.W. Eds.) Spider Mites. Their Biology, Natural Enemies and Control, pp. 349-358. Elsevier, Amsterdam.