It has involved probably the largest propagation of a single cultivar of a plant by cutting propagation at one time in New Zealand and the total plants required to set up the industry have all been grown in the space of just 5 years from the original plants leaving quarantine. Over all, costs have been 12 cents per plant.

SLOW-RELEASE HERBICIDES: AN UPDATE

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The need for effective chemical weed control in container-grown nursery stock is obvious. Equally, or perhaps more important, is the need for pesticides that are as safe as possible to society with minimum chance to contaminate the air, soil, or ground water.

Weed competition has been estimated to cause an annual loss of over 3.5 billion dollars in yield and quantity of crops in the U.S. alone (1). In nursery research studies it has been reported that 624 man-hours are required to remove weeds from an acre of one gal. (3.78 liter) containers (approximately 30,000/A) (4). At a labor rate of 5.00/hr the cost to weed an acre could exceed $3,000.

Hebicides, indeed, can reduce these costs significantly. The herbicides, however, must be effective, non-phytotoxic, and environmentally safe.

To assist in this effort slow-release herbicides have been the focus of research at Ohio State University. Original research by Varma and Smith in Georgia (9) and subsequently Ohio (1,3,5,6,7,8) have indicated the feasibility of utilizing particular pre-emergence herbicides in a slow-release form.

In 1980, Koncal (3) incorporated separately, metolachlor (Dual), alachlor (Lasso), oxadiazon (Ronstar) and oryzalin (Surflan) into tablets made of plaster-of-paris in a template. Only highly soluble herbicides leach out of the tablets and result in acceptable weed control. Solubility of metolachlor is 330 ppm, alachlor 242 ppm, ozyzalin 2.5 ppm and oxadiazon 0.7 ppm. Metolachlor and alachlor were most effective in controlling weeds, but neither oryzalin or oxadiazon were effective at all. Very good weed control was achieved for 120 days with metolachlor impregnated tablets.

In 1982, Ruizzo (5) used dicalcium phosphate with magnesium stearate to prepare tablets by dry compression in a Stokes single punch tablet machine. Metolachlor, alachlor, propachlor,

chloramben and naptalam effectively controlled weeds for 112 days with no significant injury to *Euonymus, Ligustrum, Forsythia,* and *Cotoneaster* species. One tablet (1.5 gram, 12 mm diameter) was used per 1 gal. container. Metolachlor was the most effective herbicide.

In 1986, Smith, Gorski and Moore (6) pointed out that the soluble herbicides that were effective in controlling weeds were most effective against grasses but weak with broad-leaved weed species. Metribuzin (Sencor and Lexone) was more effective in controlling a wider spectrum of weeds but was found to be more phytotoxic to woody landscape plants. Metribuzin is not a registered compound for the nursery industry in the U.S. but has the necessary solubility.

In an attempt to increase broadleaf weed control Smith and Treaster in 1987 (7) evaluated cyanazine (Blaydex) and Terbacil (Sinbar) incorporated into dicalcium phosphate tablets. Both materials controlled broadleaved weeds and grasses for 10 weeks. Cyanazine and terbacil were both too phytotoxic to the nursery stock evaluated, especially terbacil.

As a follow-up to these studies, Smith and Treaster in 1988 (8) published a report with the same compounds at 50% lower rates in an attempt to achieve acceptable weed control without the phytotoxicity. Again, weed control was acceptable for 10 weeks but injury persisted on cotoneaster and azalea with both herbicides. As

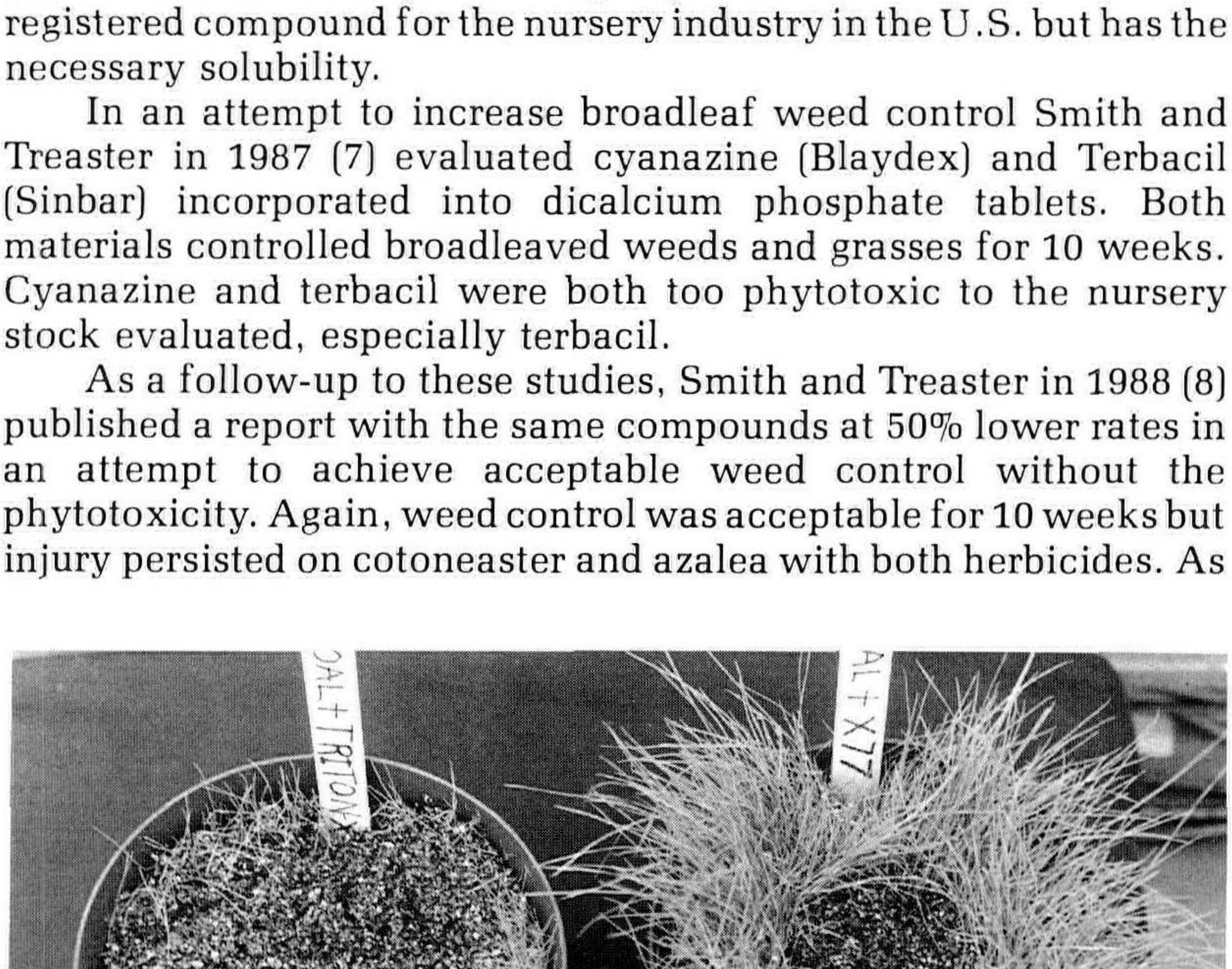

Figure 1. Weed control from slow release herbicide tablets containing: *Foreground*—oxyfluorfen (Goal), *Back Left*—oxyfluorfen (Goal) plus Triton X-100, and *Back Right*—oxyfluorfen (Goal) plus X-77.

a comparison, metolachlor tablets were non-injurious to all test species. Neither cyanazine or terbacil are registered for nursery crops.

Despite the extended time period of effective weed control achieved with metolachlor-impregnated slow-release tablets, introduction into the commercial trade seemed premature. The reason for not seeking introduction is that granular oxadiazon and oxyfluorfen compounds are superior herbicides particularly in respect to controlling specific weeds such as lesser bittercress, yellow wood sorrel, groundsel, and creeping spurge.

During the summer of 1988, Menashe Horowitz, at the Ohio State University while on sabbatical leave from the Department of Ornamental Horticultural Research Organization, Bet Dagan, Israel, pursued the process of using surfactants in the tablets to increase the solubility of the herbicides. He found that oxyfluorfen (Goal) with a solubility of 0.1 ppm could be made to move out of the tablet with the incorporation of surfactants such as X-77 or Triton X-100 (2). In general, Triton X-100 proved superior as a surfactant and did result in achieving some release of both oxyfluorfen and oxadiazon when incorporated as technical grade material into the tablet. The release is not as extensive as the more highly soluble metolachlor thus more than one tablet may be needed for a one gal. container.

These results with surfactants are encouraging. Hopefully, in the near future the right combination of pre-emergence herbicide–surfactant will be developed that is safe to plants and society in general and result in long term wide spectrum weed control in the nursery industry.

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THE STORY OF VIRUSES IN ROSES IN NEW ZEALAND[1]

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The term "high health", as used here, means "free of known virus and virus-like diseases (FKV)". Where the term "virus" is subsequently used in a general sense, it includes virus-like diseases.

THE VIRUS AND VIRUS-LIKE DISEASES

Three viruses have been serologically detected and partially characterised from roses in New Zealand. These are *Prunus* necrotic ringspot virus (PNRSV), apple mosaic virus (ApMV), and *Arabis* mosaic virus (ArMV). Of these only the first, PNRSV, has become widespread. ApMV was detected in only one plant and ArMV was detected in a few plants of one cultivar.

Two virus-like diseases affecting rose flowers can be indexed by double budding with a sensitive indicator cultivar. Rose petal fleck (RPF) is widespread in New Zealand but rose colour break (RCB), although not uncommon, is largely confined to greenhouse forcing roses.

A further virus, rose wilt virus (RWV), has been recorded as occurring in New Zealand but it has been subsequently shown that the symptoms attributed to RWV in New Zealand are, in fact, two completely unrelated diseases. The symptoms of short shoot growth, or rosetting and die back, which occur in mature plants have been shown to be associated with PNRSV and the symptoms known as proliferation, occurring on the first growth from grafted buds, are not caused by viral infection.

Roses infected with PNRSV show a wide range of one or more symptoms or may be symptomless. Symptoms include various

[1] This paper is based upon: Gardner, P. C. 1983. Virus and virus-like diseases of roses in New Zealand. Ph.D. Dissertation. Massey University, Palmerston North.