IMPROVING SLOW-RELEASE HERBICIDE TABLETS FOR CONTAINER NURSERY STOCK

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INTRODUCTION

The use of slow-release herbicide tablets have several advantages in the production of container-grown nursery stock. Included are the greater accuracy of herbicide application, greater safety to humans and plants, and reduction of possible environmental pollution. To be commercially acceptable, however, the tablets must also provide long lasting wide spectrum weed control without phytotoxicity to the plants.

Tablets have been formulated with water-soluble herbicides such as alachlor and metolachlor and, although they are effective, they do not control a broad range of weed species. Most pre-emergence herbicides currently in nursery use have a low water solubility and have not been successfully utilized in a slow-release technology.

In recent work by Horowitz *et al.* (1), the area of weed control surrounding a slow-release herbicide tablet was markedly increased by adding a surfactant to the tablet. As a follow-up to this work we conducted studies to; screen a number of surfactants; screen various herbicides and herbicide combinations; field-test the final product for weed control; and assess phytotoxicity in container-grown nursery stock.

MATERIALS AND METHODS

Slow-release herbicide tablets were produced by dry compression of dicalcium phosphate as a filler, magnesium stearate as binder, and the commercial formulation of herbicides and surfactants. The tablet-making process involved the use of a Stokes single punch tablet machine. Finished tablets measured 12 mm in diameter and weighed on the average 1.25 g/tablet.

Experiments were conducted in 1 gal. containers (18 cm. top diameter) filled with a commercial medium of Metro Mix 350. Containers were seeded with 'Seaside' bentgrass (*Agrostis stolonifera* 'Seaside'). A tablet was placed on the soil surface in the center of the pot or equidistant apart if more than one tablet was applied on the day of seeding.

A series of four experiments was conducted in order to evaluate surfactants and herbicides in greenhouse trials prior to the final tablet formulation which was evaluated outdoors on 10 species and cultivars of landscape plants.

Study No. 1—Preliminary Surfactant Evaluation. Nine surfactants were evaluated as ingredients in the tablets to ascertain their effect on the release of Goal 1.6E (oxyfluorfen). Surfactants included Buffer X, Dash, Regulaid, Triton AG 98, Triton B 1956, Triton X-100, Tween 20, Tween 80, and X-77, along with Goal only and control (no surfactant and no herbicide). Each surfactant was incorporated at a rate of 1.0% and 2.5% of product formulation. Goal was incorporated into all but the control tablets at 0.5 lb a.i.a., of product formulation. All trials were conducted in the greenhouse in 1 gal. containers seeded with 1 tablet/container. Containers were seeded and treated February 17 and evaluated March 6, 1989.

Study No. 2—Final Surfactant Evaluation. The most effective results in Study No. 1 were achieved with Goal plus Triton X-100, Tween 80, and X-77 and these were again compared at 1.0 and 2.5 percent, along with Goal only at 0.5 a.i.a. and with control tablets. Trials were conducted with 1 gal. seeded containers with either 1, 2 or 3 tablets per container in the greenhouse. Containers were seeded and treated March 11 and evaluated March 27, 1989.

Study No. 3—Preliminary Herbicide Evaluation. Five pre-emergence herbicides and four herbicide combinations were compared to control tablets. The rates for each product were company recommendations and half rates a.i.a. in the combination treatments. Triton X-100 was incorporated into all but the control tablets at 1.0 percent. Herbicide treatments included Dual (metolachlor), Gallery (isoxaben), Goal (oxyfluorfen), Ronstar (oxadiazon) and Surflan (oryzalin). The combination treatments were Dual plus Gallery, Dual plus Goal, Dual plus Ronstar, and Dual plus Surflan. All containers were seeded with bentgrass. Containers were seeded and treated April 3 and evaluated April 17, 1989.

Study No. 4—Final Herbicide Evaluation. The least effective herbicide in study No. 3 was Gallery alone and in combinations with Dual so was dropped from further evaluation. Otherwise all herbicides used in study No. 3 were repeated, with some adjustment in rates. Each herbicide treatment was further evaluated with either 1, 2 or 3 tablets per container spaced equally apart. The surfactant added was again Triton X-100. Containers were seeded and treated April 24, and evaluated May 10, 1989.

Study No. 5—Nursery Evaluation. Tablets were prepared with Triton X-100 at 1.0% and the combination of Goal at 0.5 lb. a.i.a. and Dual at 2.0 lb. a.i.a. The plant species and cultivars evaluated for phytotoxicity and weed control included:

Chamaecyparis pisifera 'Boulevard'
Cotoneaster dammeri 'Royal Beauty'
Euonymus fortunei 'Emerald Cushion'
Euonymus fortunei 'Emerald 'n Gold'
Forsythia × *intermedia* 'Spring Glory'
Pachysandra terminalis
Rhododendron 'PJM'
Rhododendron 'Hino-pink'
Spiraea × *bumalda* 'Gold Flame'
Spiraea nipponica var. *tosaensis* 'Snowmound'

Plants were potted in 2 gal. containers, placed outdoors and treated on June 14 and evaluated June 29, July 13, July 27, and August 10, 1989. Each container was treated with either 2, 3 or 4 tablets.

RESULTS AND DISCUSSION

Study No. 1—Preliminary Surfactant Evaluation. The objective of this study was to screen a number of surfactants using Goal 1.6E at 1.0 lb. a.i.a. as the test herbicide. Goal was selected as the test herbicide due to its low solubility of 0.1 ppm and its wide spectrum of weed control. The most effective weed control was achieved with the surfactants Triton X-100, Tween 80, and X-77 and these were selected for further evaluation. The 2.5% formulation of Triton X-100 and X-77 were superior rates to 1.0%.

Study No. 2—Final Surfactant Evaluation. Triton X-100, Tween 80, and X-77 were further evaluated at 1.0 and 2.5% with Goal 1.6E at 0.5 lb. a.i.a. as the herbicide. The most effective surfactant treatments were Triton X-100 at the 3 tablet rate at both 1.0 and 2.5% surfactant levels. Since the area of weed control was similar, Triton X-100 at 1.0% was selected for further evaluation. With all treatments there were significant increases in weed control, as expected when the number of tablets were increased. However, the best treatments were still only yielding approximately 50% weed control in one-gal. containers which is not good enough from a commercial standpoint.

Study No. 3—Preliminary Herbicide Evaluation. Among the most effective herbicides for container-grown landscape crops are Goal, Ronstar, Surflan, and a relatively new material, Gallery. All are relatively insoluble materials, for example: Goal = 0.1 ppm, Ronstar = 0.7 ppm, Surflan = 2.4 ppm, and Gallery = .0001 ppm. Dual, however, is very water soluble at 530 ppm. The idea was to evaluate each herbicide separately with Triton X-100 and in combination with Dual and Triton X-100.

The preliminary results were not strikingly different in 1 gal. containers although Gallery and Gallery plus Dual were the least effective. Thus, these two treatments were dropped from further evaluation.

Study No. 4--Final Herbicide Evaluation. With the exception of Gallery, the herbicide treatments in study 4 were a repeat of study No. 3. However, 1, 2 and 3 tablets per 1 gal. container were evaluated. As with study No. 2, as the number of tablets increased the weed control increased.

The results indicate that 80% weed control was achieved with 3 tablets of Goal at 0.5 lb. a.i.a. and 90% with Goal at 1.0 lb. a.i.a. Furthermore, Dual at 3 tablets yielded 100% weed control of 'Seaside' Bentgrass. The combination of Goal (0.5 lb. a.i.a.) and Dual (2.0 lb. a.i.a) resulted in 98% weed control. Recognizing that Dual as an herbicide is most effective against grasses and Goal most effective against broadleaf weeds, it was decided to continue research with the combination product of Triton X-100 at 1.0%, Goal at 0.5 lbs. a.i.a. and Dual at 2.0 lb. a.i.a.

Study No. 5—Nursery Evaluation. Ten species of woody nursery stock were planted into 2 gal. containers and treated with either 2, 3 or 4 tablets per container. There was no evidence of phytotoxicity 6 weeks from treatment on any plant. However, at 8 weeks some retardation of growth was observed with *Spiraea* × *bumalda* 'Gold Flame' and *S. nipponica* var. *tosaensis* 'Snowmound'.

Acceptable weed control for 2 tablets was 8 weeks, 3 and 4 tablets, 8+ weeks. These containers were not sown to 'Seaside' Bentgrass. The native weeds were evaluated and the following weed species were controlled: lesser bittercress, spotted spurge, and oxalis—all weeds that cause significant labor problems in container nurseries. Dual alone will not control these weed species.

SUMMARY

A series of 4 studies was conducted to determine the most effective surfactant and herbicide to incorporate into slow-release tablets for the most effective control of weeds without plant phytotoxicity. The most effective surfactant was Triton X-100 and the most effective herbicide was a combination of Dual and Goal which results in broad spectrum weed control. These tablets were then field tested on 10 species and cultivars of woody landscape plants. There was no observable phytotoxicity for 8 weeks on 8 of 10 plant selections and acceptable weed control was achieved with 2 tablets for 8 weeks, and 3 and 4 tablets for 8+ weeks.

Continued research is needed to evaluate more crops, varying rates, and economic analysis.

LITERATURE CITED

1. Horowitz, M , E M Smith, S F. Grorski, and S.A. Treaster 1989. Potential of slow-release tablets as carriers of herbicides and growth regulators for containerized ornamentals. Ornamental Plants A Sum of Research, 1989 *Spec Circ. 123*. The Ohio State University, Columbus, OH 43210.