# An Evaluation of Repetitive Summer Horticultural Oil Sprays on Selected Woody Landscape Plants[1]

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## Abstract

In order to evaluate the effect of repetitive verdant horticultural oil sprays on plant growth and appearance, 32 different species/cultivars of shade trees, evergreens, and woody shrubs were sprayed three times during the 1994 growing season with 2% SunSpray Ultra-Fine spray oil. Visual phytotoxicity ratings were assigned to treated plants and growth affects were measured by measuring leaf area and incremental twig growth following the last spray application. No phytotoxicity was observed on any of the 32 species/cultivars of woody plants using three repetitive verdant horticultural oil sprays. Collectively, repetitive oil sprays did not significantly affect incremental twig growth or leaf area of treated plants. Results from this study show that repetitive sprays of 2% SunSpray Ultra-Fine spray oil can be used safely on shade trees, evergreens, and deciduous landscape shrubs commonly grown in the upper mid-west.

**Index words:** horticultural oils, verdant spray, phytotoxicity, woody landscape plants, incremental twig growth, and leaf area.

**Species used in this study:** Norway Maple (*Acer platanoides* L.); Red Maple (*Acer rubrum* L.) 'Red Sunset'; River Birch (*Betula nigra* L.); Thornless Crusgalli Hawthorn (*Crataegus crusgalli inermis* L.); Washington Hawthorn (*Crataegus phaenopyrum* L. f.); Winter King Hawthorn (*Crataegus viridis* L.); 'Marshall Seedless' Green Ash (*Fraxinus pennsylvanica* Marsh.); 'Patmore' Green Ash (*Fraxinus pennsylvanica* Marsh.); 'Shademaster' Honeylocust (*Gleditsia triacanthos inermis* Willd.); 'Skyline' Honeylocust (*Gleditsia triacanthos inermis* Willd.); 'Adams' Crab Apple (*Malus* spp. Mill); 'Beverly' Crab Apple (*Malus* spp. Mill); 'Floribunda' Crab Apple (*Malus* spp. *Sieb.*); 'Snowdrift' Crab Apple (*Malus* spp. Mill.); 'Spring Snow' Crab Apple (*Malus* spp. Mill.); Pin Oak (*Quercus palustris* Muenchh.); 'Greenspire' Littleleaf Linden (*Tilia cordata* Mill.); Colorado Blue Spruce (*Picea pungens glauca* Engelm.); Austrian Pine (*Pinus nigra* Arnold); Douglas Fir (*Pseudotsuga menziesii* Mirb.); American Arborvitae (*Thuja occidentalis* L.); Burning Bush (*Euonymus alatus* Thurnb.); 'Compactus' Dwarf Burning Bush (*Euonymus alatus* Thurnb.); Snowmound Spiraea (*Spiraea nipponica tosaensis* Maxim.); 'Miss Kim' Miss Kim Dwarf Lilac (*Syringa patula* Palib.); 'Minuet' Minuet Lilac (*Syringa* x *prestoniae* McKelv.); 'Royalty' Royalty Lilac (*Syringa* x *prestoniae* McKelv.); Yew (*Taxus* spp. L.); Arrowwood Viburnum (*Viburnum dentatum* L.); European Cranberrybush (*Viburnum opulus* L.); American Cranberrybush (*Viburnum trilobum* Marsh.); 'Alfredo' Compact American Cranberrybush (*Viburnum trilobum* Marsh.).

## Significance to the Nursery Industry

Horticultural oils have shown to be an effective control against a wide variety of sap-feeding as well as some defoliating insects. In spite of oil's effectiveness and applicator safety, oils are still under utilized in the green industry. One major concern is the potential phytotoxicity of oils on woody landscape plants due to differences in local and regional climatic conditions as well as woody plant species and cultivars.

Results from this study show that repetitive sprays of 2% SunSpray Ultra-Fine spray oil can be used safely on shade trees, evergreens, and deciduous landscape shrubs commonly grown in the upper mid-west. The information presented here should provide the grower and landscape manager with increased confidence in knowing that oils are not harmful to plants and do not significantly affect plant growth. This should facilitate a greater acceptance and use of horticultural oils in pest management programs.

## Introduction

Historically, horticultural oils were used at the turn of the century as a dormant treatment to control fruit pests such as San Jose scale overwintering on bark. These early oil formulations often caused phytotoxic effects when applied to non-dormant plants (4). More recently, dormant applications by arborists, nurserymen, and landscapers using improved oil formulations were applied to control overwintering forms of many insects and mites on bark. However, it is only in the last few years that horticultural oils have been utilized as a verdant spray to control bark and leaf feeding pests in the growing season. Studies have shown summer oil sprays to be effective against a variety of sap-feeding arthropod pests including scales, psyllids, plantbugs, lacebugs, leafhoppers, and mites (1, 2, 3, 5, 7, 8, 9, 11, 12, 13, 15, 16, 17). In addition, Baxendale and Johnson (1, 2) found oils to control defoliators such as euonymus webworm and European pine sawfly.

Despite these studies, the use of horticultural oils in urban horticulture and nurseries has not been fully realized. In certain quarters of the industry, there is still a reluctance to employ horticultural oils as part of a comprehensive plant management program (10). A major reason for the limited use of oil sprays are the concerns and fears of members of the green industry of potential phytotoxicity (10, 11).

Limited data is available on the phytotoxicity of horticultural oils when applied during the growing season to the great variety of woody landscape plants. Only a few formal studies have focused on the potential phytotoxicity of horticultural oils on woody plants (1, 2, 6, 14).

Baxendale and Johnson (1) found certain *Juglans* species/cultivars to be highly sensitive to 3% SunSpray 6E horticultural oils sprays. They also discovered that Colorado blue spruce, Chinese juniper, and 'Blue Rug' juniper loose their

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blue color when sprayed with oil. In the same study, oil sprays applied to young silver maple (*Acer saccharinum*) trees were not detrimental.

In a more comprehensive study in Maryland, Davidson et al. (6) examined the effects of two to four repetitive sprays of 2% SunSpray 6E horticultural oil over the course of one growing season. Of the 52 species and cultivars of shade trees and woody shrubs sprayed, phytotoxicity was negligible in spite of the droughty conditions. They observed that nine species showed significant growth differences between treated and untreated plants. All treated plants averaged 1.7 cm (0.7 in) more growth than untreated plants (6). Mizell (14) found no evidence of phytotoxicity on over 56 different species and cultivars growing under environmental conditions found in south Georgia and north Florida nurseries even after five applications of SunSpray Ultra-Fine spray oil at ten day intervals.

While these studies have significantly contributed to the overall knowledge base of horticultural oils, application of this information by growers and managers may be limited due to differences in local and regional climatic conditions as well as local woody plant species and cultivars. To the best of the author's knowledge, no comprehensive study has been conducted on the possible phytotoxic and growth effects of repetitive horticultural oil sprays on woody plant materials commonly grown and planted in the mid-western United States.

As part of an overall research effort by the author, focusing on incorporation and use of horticultural oils into integrated pest management (IPM) and plant health care (PHC) programs in the mid-western United States, a study was initiated in order to determine the phytotoxic effects of repetitive verdant applications of 2% SunSpray Ultra-Fine 6E horticultural oil on shade tree, evergreen, and woody shrub species and cultivars commonly grown. In addition, the effects of repetitive verdant applications of oil might have on overall plant growth as measured by incremental twig growth and leaf area.

## Materials and Methods

During the 1994 growing season, seventeen different shade trees, eleven woody shrubs, and four evergreen species/cultivars were treated with 2% SunSpray 6E Ultra-Fine horticultural oil. The plants were growing in north central Illinois at the Beeson's McHenry County Nursery Inc. near Harvard, IL.

Treatments of 2% SunSpray 6E Ultra-Fine horticultural oil were applied three times, at approximately four week intervals, during June, July, and August, 1994. Ten trees of each species/cultivar were sprayed until runoff using a trailer mounted Meyers 1136 liter (300 gal) capacity sprayer operated at 200 psi. Ten woody shrubs and evergreens of each species/cultivar were sprayed until runoff using a 11.4 liter (3 gal) capacity Solo hand sprayer. An additional ten shade trees, evergreens, and woody shrubs of each species/cultivar were not sprayed and served as controls.

In mid-September, 1994, prior to leaf drop, foliage and twig samples were taken from each of four quadrants (N, S, E, W) of each treated and untreated plant. The terminal 46 cm (18 in) of a given branch was removed with either hand pruners or a pole pruner and placed in a plastic bag. Prior to bagging, the samples were tagged as to species/cultivar, treatment, tree number, and aspect. The field samples were transported back to the laboratory at The Morton Arboretum, Lisle, IL, and held in a walk-in cooler at 4.4C (40F). Because the Norway maples evaluated in this study were much taller than the other shade tree species/cultivars, the crown of these trees was divided into an upper and lower zone and four samples were taken from each zone as described above.

Incremental twig growth was measured to the nearest 0.1 cm (0.04 in) from the previous internode for all samples using a standard plastic ruler. In order to measure leaf area, four to six mature leaves were removed from each twig sample, placed in a plant press and dried. After drying, the individual leaves were measured to the nearest 0.1 $mm^2$ (0.01 $in^2$) using a Delta-T area meter (model # PM-910A).

Twig and branch samples were not taken for the evergreen and certain woody shrub species/cultivars due to the destructive nature of the sampling procedure and its potential effect on plant growth, shape, and marketability. In addition, twig and branch samples were not taken on all three species/cultivars of hawthorn, *Malus* 'Floribunda' crabapple, and *Tilia cordata* 'Greenspire' because they had been sheared and/or pruned inadvertently just prior to the sampling of twigs and foliage in mid September 1994.

Prior to each spray application and just prior to collecting foliage and twig samples, all plants were evaluated for evidence of phytotoxicity using a five point rating scale as described by Davidson et al. (6) where 1 = no visible symptom, 2 = slight yellowing on some leaves, 3 = moderate yellowing on most leaves, but no burn, 4 = burn, but no dieback, and 5 = dieback.

Local weather conditions were observed and recorded on site prior to each spray application. A portable hand-held sling psychrometer was used for measuring local relative humidity. Maximum and minimum temperatures and rainfall measurements were obtained from the Rockford, IL, weather service office approximately 30 miles southwest of the nursery site.

Response to treatments for each species/cultivar was analyzed by one-way ANOVA. Significant differences in incremental twig growth and leaf area for each species/cultivar was identified using a Student's t-test ($P < 0.05$).

## Results and Discussion

*Climatic conditions.* Mean maximum temperatures for May-August, 1994 were within ±1C (2F) of the 30 year norms. The mean monthly temperature for May was 23C (73F), June = 29C (82F), July = 27C (80F), and 26C (78F) for August. The McHenry County Nursery depended on natural rainfall for its supply of water for plants. Total rainfall for May-August, 1994 was 42.1 cm ( 16.6 in) which was 0.3 cm (0.12 in) above the 30-year norm of 41.8 cm (16.5 in). Rainfall was 5.7 cm (2.3 in) below normal for May (3.6 cm) (1.4 in) and 3.3 cm (1.3 in) below normal for July (7.2 cm) (2.8 in). June and August had above normal rainfall of 15.3 cm (6.0 in) and 16.0 cm (6.3 in), respectively.

Mean relative humidity (RH) for May was 58% and 65, 78, and 79% for June, July, and August, respectively. Normal RH values for these months are 66–74%. Given the above climatic conditions, this study afforded an excellent opportunity to evaluate repetitive horticultural oil sprays under very normal climatic conditions.

Weather conditions for the first spray date of June 29, 1994, were a mean temperature of 22C (72 F), RH = 77%, wind speed <7 mph, with partly cloudy skies. On the second spray date (July 21, 1994), the mean temperature was 23C (74F), RH = 78%, wind <7 mph, and partly cloudy skies. The third and final spray date (August 29, 1994) had a mean temperature of 17C (63F), RH = 72%, wind <7mph, and partly cloudy skies.

*Phytotoxicity.* Collectively, none of the shade tree, evergreen, or woody shrub species/cultivars showed any evidence of phytotoxicity either between spray applications or after three repetitive treatments. Colorado blue spruce (*Picea pungens)* trees sprayed with oil lost their blue bloom, but no other effects were observed. Davidson et al. (6), and Baxendale and Johnson (1) also observed that horticultural oils removed the blue color from 'Sky Rocket', 'Blue Rug', and Chinese junipers as well as Colorado blue spruce trees.

Comparing plant genera common to this study and the previous studies (1, 6, 14) no phytotoxic effects were observed on *Acer, Betula, Euonymus, Fraxinus, Gleditsia, Malus, Pinus, Quercus, Spiraea, Syringa, Taxus, Thuja, Tilia,* and *Viburnum* when sprayed with 2 to 3% rates of oil for two to five times.

*Incremental twig growth and leaf area.* Collectively, repetitive verdant horticultural oil applications had no significant effect on plant growth for both shade tree and woody shrub species/cultivars as measured by incremental twig growth and leaf area. A slight, but significant (t = 3.65, P < 0.0003) increase in incremental twig growth of 2.5 cm (1.0 in) was observed for shade trees treated with oil as compared to untreated trees. However, no significant differences were found for incremental twig growth of woody shrubs or leaf areas of either group.

*Incremental twig growth on shade tree species/cultivars.* The overall effect of repetitive oil sprays on incremental twig growth in this study was similar to findings by Davidson et



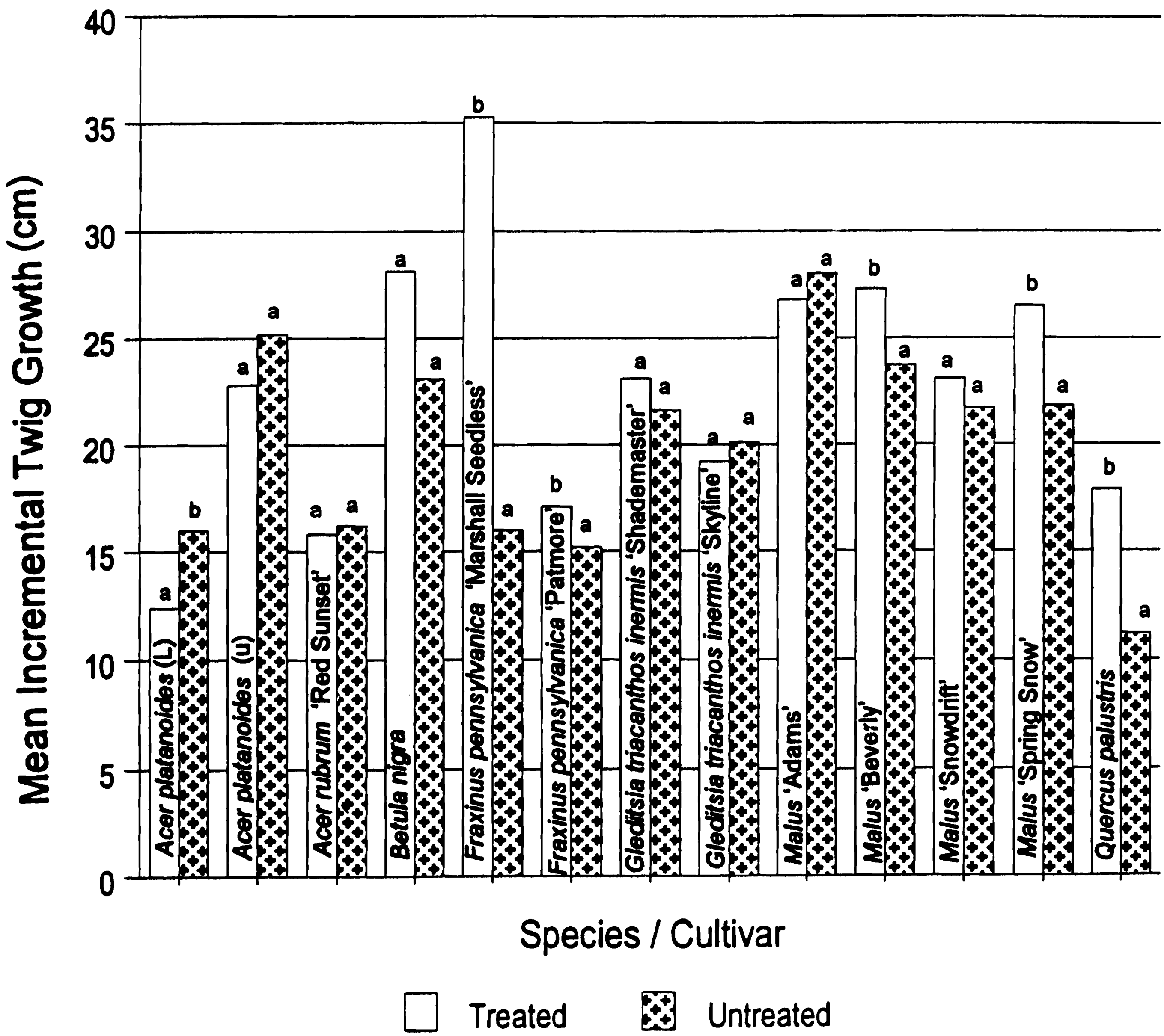


**Fig. 1. Mean incremental twig growth of shade tree species/cultivars treated with three repetitive sprays of SunSpray Ultra-Fine spray oil, summer 1994. Paired treatment values for each species/cultivar followed by the same letter are not significantly different (P < 0.05; Student's t-Test).**

al. (6). They observed that treated plants exhibited a mean of 1.7 cm (0.7 in) more growth than untreated plants. Their study was conducted in Maryland during the 1988 drought and they speculated that there may have been a physiological basis for this trend.

Two other species common to our study and Davidson's et al. (6) study were honeylocust 'Shademaster' (*G. triacanthos*) and pin oak (*Q. palustris*). In Davidson's study, neither tree species showed any significant difference between treated and untreated trees for incremental tree growth.

Similar results were observed in this study for honeylocust 'Shademaster', but not for pin oak. Incremental twig growth was significantly greater for treated pin oak trees versus untreated trees (Fig. 1).

Norway maple (*A. platanoides*), 'Marshall Seedless' ash (*F. pennsylvanica),* and red maple (*A. rubrum*) common both to the Davidson et al. (6) study and this one, showed different responses to repetitive oil sprays. Norway maples (*A. platanoides*) treated in Maryland exhibited greater incremental twig growth, just opposite of the findings in this study (Fig. 1). Incremental twig growth for 'Marshall Seedless' ash (*F. pennsylvanica)* in the Maryland study was nonsignificant while in our study, treated ash trees grew more than untreated (Fig. 1). Incremental twig growth for red maples in Illinois was nonsignificant while red maples (*A. rubrum*) treated in Maryland had less growth than untreated red maples (*A. rubrum*) (Fig. 1). There are many factors that could be responsible for these differences including climate, soils, cultivar effects, and cultural conditions.

Mean incremental twig growth for *F. pennsylvanica* 'Marshall Seedless', *F. pennsylvanica* 'Patmore', *Malus* 'Beverely', *Malus* 'Spring Snow', and *Q. palustris* was significantly greater on treated trees than on untreated trees (Fig.1). One exception occurred in the lower zone of *A. platanoides* trees in which untreated twigs grew significantly more than twigs sprayed with oil (Fig. 1).



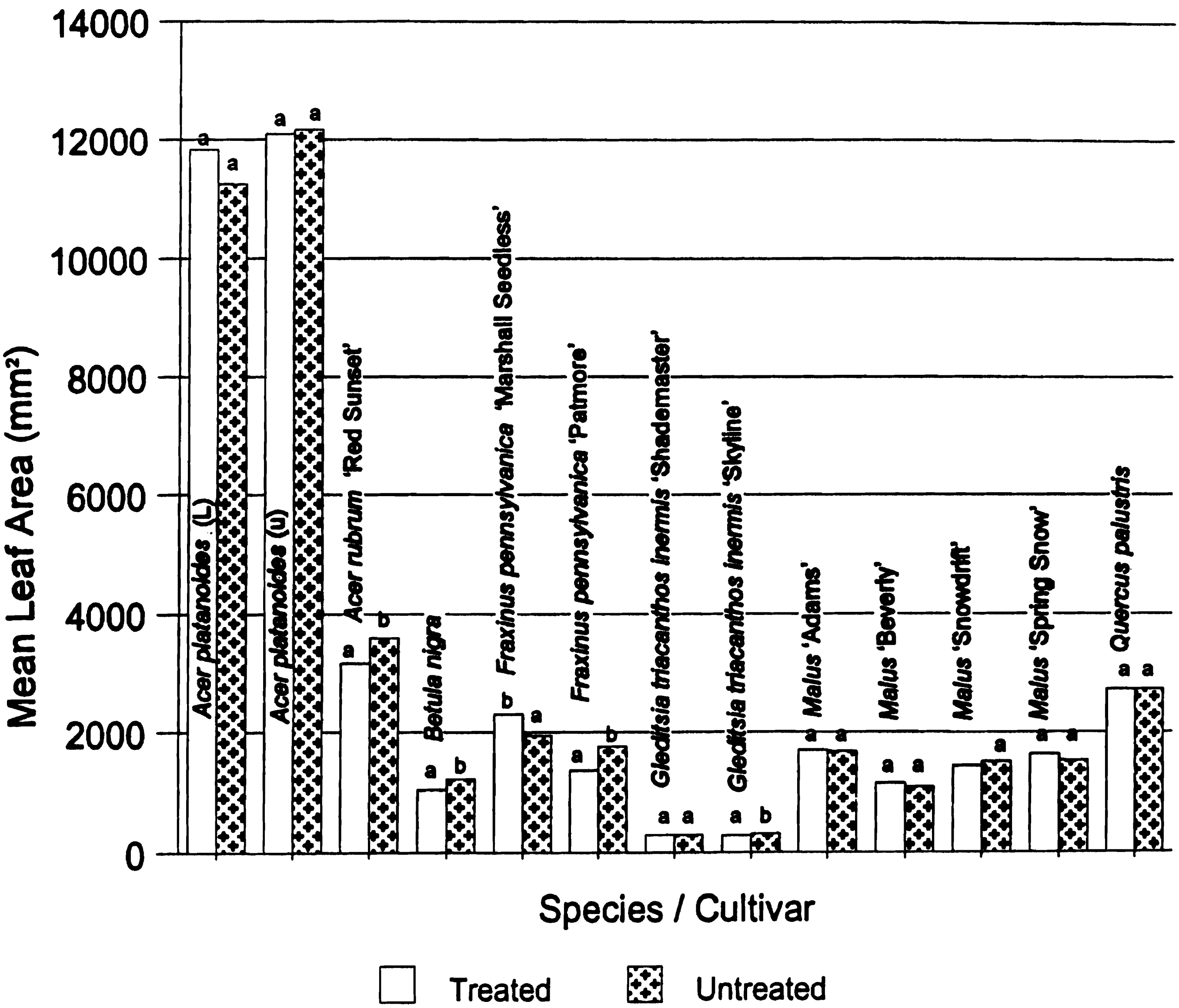


**Fig. 2. Mean leaf area of shade tree species/cultivars treated with three repetitive sprays of SunSpray Ultra-Fine spray oil, summer 1994. Paired treatment values for each species/cultivar followed by the same letter are not significantly different (P < 0.05; Student's t-Test).**

*Leaf area on shade tree species/cultivars. Acer rubrum* 'Red Sunset', *Betula nigra*, *F. pennsylvanica* 'Marshall Seedless', *F. pennsylvanica* 'Patmore', and *Gleditsia triacanthos inermis* 'Skyline' were significantly affected (Fig. 2). With the exception of 'Marshall Seedless' ash *(F. pennsylvanica)*, mean leaf area was less on treated foliage compared to untreated foliage (Fig. 2).

*Incremental twig growth for woody shrub species/cultivars*. Only two woody shrub species/cultivars (*E. alatus* 'Compactus' and *S. patula* 'Miss Kim') showed significantly less incremental twig growth for treated plants versus untreated plants (Fig. 3). *Euonymus alatus* 'Compactus' shrubs treated with oil had slightly greater incremental twig growth compared to untreated plants although this trend was not significant. Davidson et al. (6) made a similar observation in their study.

*Leaf area for woody shrub species/cultivars. Euonymus alatus, Syringa* x *prestoniae* 'Minuet Lilac', and *Viburnum opulus* had significantly less leaf area for sprayed foliage versus untreated plants (Fig. 4). The reverse was true for *S. patula* 'Miss Kim' (Fig. 4).

No phytotoxicity was observed on 32 species/cultivars of woody plants using three repetitive verdant horticultural oil sprays. Repetitive horticultural oil sprays did not significantly affect incremental twig growth or leaf area of treated plants with the exception of the incremental twig growth for shade trees in which treated trees exhibited slight but, significantly more growth than untreated trees.

In summary, results from this study demonstrate that repetitive sprays of 2% SunSpray Ultra-Fine spray oil can be used safely on shade trees, woody shrubs, and evergreens commonly grown in the upper mid-west. Horticultural oils provide the nursery grower and landscape manager with an



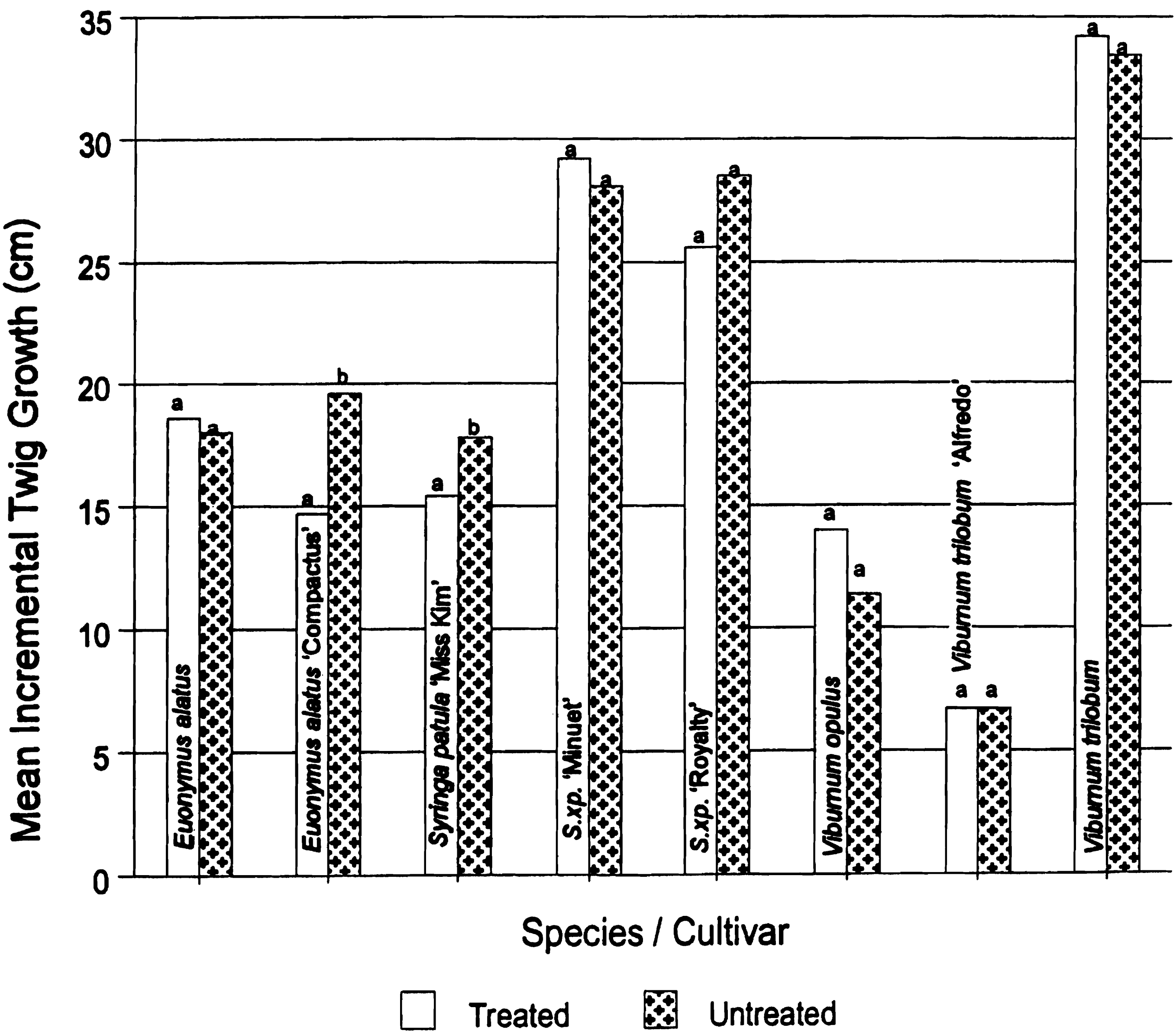


**Fig. 3. Mean incremental twig growth of woody shrub species/cultivars treated with three repetitive sprays of SunSpray Ultra-Fine spray oil, summer 1994. Paired treatment values for each species/cultivar followed by the same letter are not significantly different (P < 0.05; Student's t-Test).**

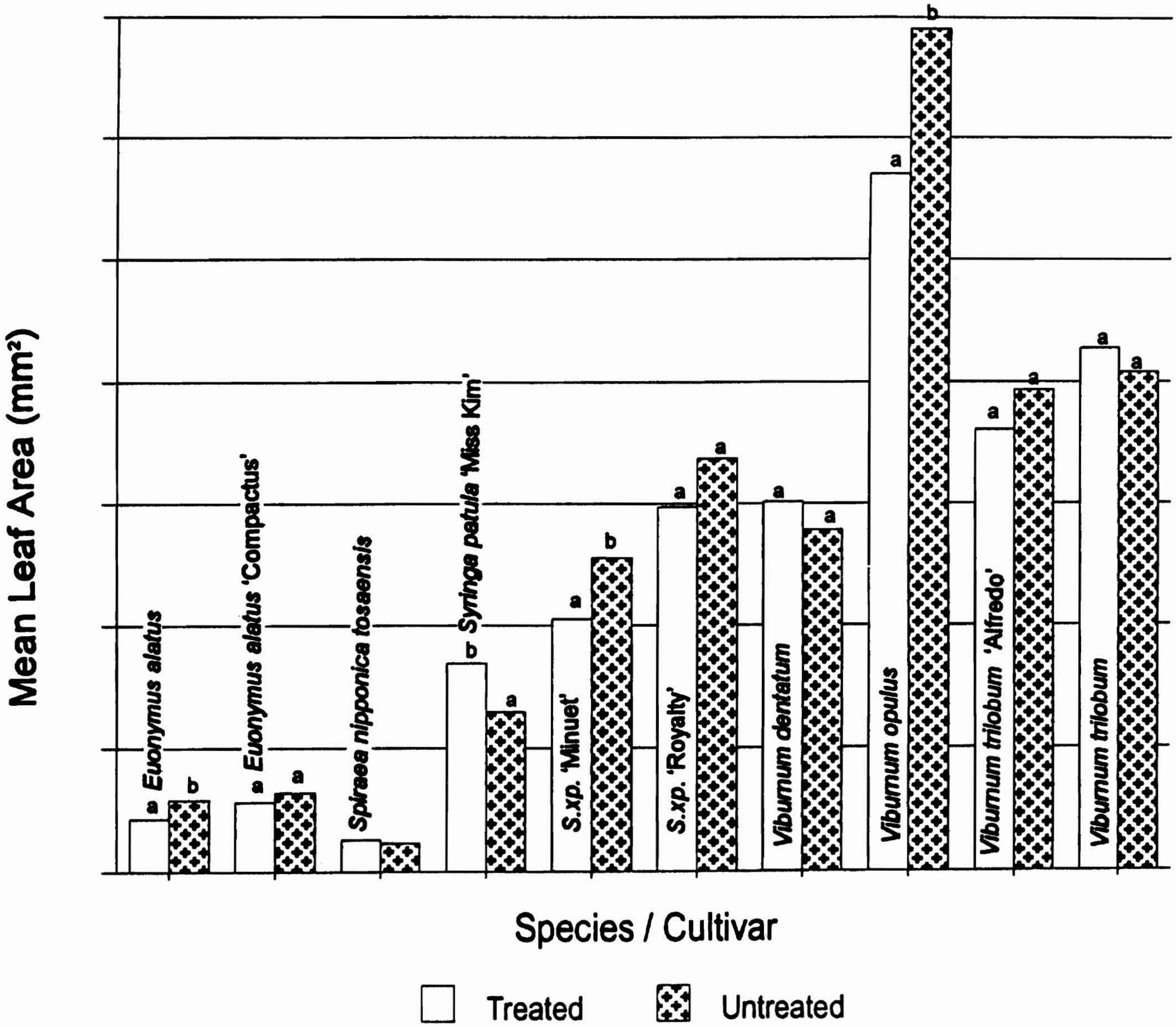


**Fig. 4.** **Mean leaf area of woody shrub species/cultivars treated with three repetitive sprays of SunSpray Ultra-Fine spray oil, summer 1994. Paired treatment values for each species/cultivar followed by the same letter are not significantly different ($P < 0.05$; Student's t-Test).**

effective pest management tool for combating insect and mite pests without the risk of plant damage and detrimental effects on plant growth. In addition, horticultural oils are environmentally safe due to rapid degradation by evaporation, have little pesticide residue, are less harmful to beneficial organisms, are noncorrosive to spray equipment, provide a wide range of pest control, and are virtually nonpoisonous to the applicator. Proper and effective incorporation of horticultural oils into a pest management program can result in reliable pest control along with the assurance of plant safety.

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# Evaluation of Biological and Chemical Applications for Control of Iris Borer[1]

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## Abstract

Two species of entomopathogenic nematodes, *Steinernema carpocapsae* and *Heterorhabditis bacteriophora,* and two synthetic chemicals, Dimetheoate and Imidachloprid, were evaluated for suppression of the iris borer, *Macronoctua onusta,* on bearded iris. Field trials were conducted in prepared planting beds of bearded iris established at the Central Maryland Research and Education Center in Ellicott City, MD. Examination of larval galleries in the rhizome and number of live larvae found were used to evaluate the effectiveness of each treatment. The applications of all rates of entomopathogenic nematodes and the systemic insecticide, Imidachloprid, gave control equal to that of Dimethoate. All treatments gave significant control of iris borer compared to the control. Imidachloprid reduced borer larvae by 87% reduction; *S. carpocapsae* (all rates and aerated and none aerated) provided 100% control; *H. bacteriophora* provided 87% control; as did Dimetheoate.

**Index words:** biological control, Noctuidae moth, *Macronoctua,* entomopathogenic nematodes, systemic insecticide.

**Insecticides used in this study:** Cygon 2E (Dimetheoate); 0, 0-dimethyl S-methylcarbamoylmethyl phosphorodithioate; Marathon (Imidachloprid); 1-[(6-chloro-3-pyridinyl) methyl]-N-nitro-2-imidazolidinimine.

**Species used in this study:** bearded iris, *Iris X germanica*; *Steinernema carpocapsae* (Vector); *Heterorhabditis bacteriophora* (Lawn Patrol).

### Significance to the Nursery Industry

Bearded iris are the most popular iris species grown for landscape purposes. The iris borer, *Macronoctua onusta,* is a key pest of this herbaceous perennial. The feeding of the larvae of the iris borer causes wounds and dieback of infested plants. The number of safe, effective chemical controls for iris borer is extremely limited. This field trial demonstrates that entomopathogenic nematodes offer an viable biological control option for controlling iris borer.

### Introduction

The iris borer, *Macronoctua onusta* Grote, family Noctuidae, causes major damage to bearded iris, *Iris X germanica*. Eggs are laid on foliage in the fall. Overwintering eggs on old leaves hatch in early spring, and larvae make slender feeding channels into new leaves somewhat resembling the burrows of leafminers. The larva is white-pink with a brown head capsule. The larvae feed within leaf sheaths, in stems and flower buds, gradually moving down into the rhizomes. Fully grown larvae can be up to 5 cm (2 in) in length. They complete their growth, pupate, and emerge as dusky brown moths by late summer and early autumn (2).

Cleaning up and destroying old iris leaves and stems in late autumn is the best cultural control method (2). Unfortu-

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