EFFICACY OF CHLORINATED IRRIGATION WATER FOR CONTROLLING ROOT ROT ORGANISMS

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Abstract. Five months of irrigation with 0 2 ppm free chlorine did not result in reduced root isolations of *Pythium, Phytophthora,* or *Rhizoctonia*, or number of propagules in the growth medium of *Juniperus conferta* 'Blue Pacific' Number of propagules in the growth medium of *Elaeagnus pungens* (silver thorn) was generally less for chlorinated than nonchlorinated plants

INTRODUCTION

The chlorination of potable water has been a common practice for many years (4). Recently, irrigation water for nursery crops has been chlorinated for the purpose of suppressing fungal organisms. Daughtry (1) reported that chlorination of nursery irrigation water resulted in a 30% reduction in fungicide use.

Water restrictions in Florida necessitate that plant producers minimize water use and reclaim surface water. Reclaimed or recirculated water has been thought of as a potential source of pathogens. Consequently, chlorination of runoff water may be beneficial when water is reused. Even though nursery irrigation water has been chlorinated and disease suppression appeared successful, the efficacy of chlorination has not been documented under nursery conditions. The following study was conducted to document the efficacy of chlorinating reclaimed runoff water.

MATERIALS AND METHODS

The study was conducted at Gramling Nursery, Inc., Plant City, Florida (latitude 28° 00'N, longitude 82° 07'W). Gramling Nursery collects runoff from a 17 acre area in a ⅓ acre pond that is about 15 ft deep. A gas chlorine system (Advance Chlorinator Model 480 (481C1/VR428C) Capital Controls Co., Colmar, Pennsylvania 18915) was installed near the irrigation pump, and a Lovibond® 2000

Comparator TK 100 (The Tintometer Company, Williamsburg, Virginia 23185) was used to monitor free chlorine in the irrigation water using N,N-diethyl-p-phenylenediamine (DPD) reagent. Reclaimed water was chlorinated (0.2 ppm free chlorine) during each irrigation applied to half the nursery acreage while the other half received reclaimed water without chlorination. Plants were irrigated with about 1 in. of water every other day, or as needed.

At the initiation of the study (March, 1989), 200 plants of *Elaeagnus pungens* (silver thorn) and *Juniperus conferta* 'Blue Pacific' were placed in the chlorinated and 200 of each in the nonchlorinated area. 'Blue Pacific' was chosen based on previous observations that it was very susceptible to the root-rot pathogens, *Pythium, Phytophthora,* and *Rhizoctonia* and that *Elaeagnus* was less susceptible than 'Blue Pacific' juniper. The 'Blue Pacific' juniper plants were potted December 28, 1988 and the silver thorn were potted January 24, 1989. The container medium was a 50% sedge peat: 25% pine bark: 15% cypress sawdust, and 10% builder's sand (by volume). The medium was amended with dolomitic limestone to adjust pH to between 6.0 and 7.0, and with 3 lb/yd^3 of Step (trademarked micronutrient fertilizer of O. M. Scott and Sons Co., Marysville, Ohio 43041). Lesco 20-6-12 (a trademarked fertilizer of Lakeshore Equipment & Supply, Co., Elyria, Ohio, 44036) was surface-applied at potting (17.3 g/container or 2 tsp. to each trade 1-gal. container), and repeated about every 4 months.

Water samples for pathogen analysis were taken prior to chlorination (March) from the pond and irrigation nozzles during irrigation, and sampling was repeated in July. The water was centrifuged and propagules counted. Each month (April to August), 5 plants of each species were randomly removed from the chlorinated and nonchlorinated areas. Root pieces from each plant were treated and stained according to the procedures of the University of Florida Extension Plant Disease Clinic. *Pythium, Phytophthora,* and *Rhizoctonia* counts were made for roots, and *Pythium* and *Phytophthora* counts made for the growth medium. Growth medium and root samples were also taken in March prior to chlorination. Propagule numbers for the growth medium were obtained using growth medium particles less than 1.19 mm or 14 mesh (U. S. Standard Sieve #16).

Twenty 3-gal. *Gardenia jasminoides, Ilex cornuta* 'Dwarf Burford', *Juniperus chinensis* 'Parsonii', and *Podocarpus macrophyllus* plants were placed in both the chlorinated and nonchlorinated areas at the initiation of the study. Twenty 1-gal. *Hibiscus rosa-sinensis* (green and variegated) plants were also placed in each area. Tissue samples were taken from the uppermost mature leaves of each species in March before chlorination, and

again in July. Three composite samples were taken from each species except *Hibiscus*. One composite sample was taken from nonvariegated *Hibiscus* and one composite sample was taken from variegated *Hibiscus* plants. Tissue was dried for 24 hr. at 160 °F and chloride percentages determined by Soil and Plant Lab, Santa Clara, California 95050.

During July, August, and September, leachates were collected (6) prior to root isolation and growth medium propagule determinations were made for the 5 chlorinated and 5 nonchlorinated *Elaeagnus* plants. Leachate chloride levels were determined according to procedures of the University of Florida Extension Soil Testing Laboratory (5).

RESULTS AND DISSCUSSION

Data for the roots and growth medium indicate that *Elaeagnus* roots and growth medium had a smaller percentage of isolations and number of propagules, respectively, than did juniper (Tables 1 and 2). Root isolation percentages and growth medium propagule numbers were generally smaller for the chlorinated than for the nonchlorinated *Elaeagnus*. Root and growth medium data for both species varied considerably, but propagule numbers were higher for chlorinated than for nonchlorinated juniper plants during April, May, and June. Shoot chlorosis, typically associated with root rot, was exhibited after June by many of the juniper plants in both the chlorinated and nonchlorinated areas. This chlorosis concurs with large numbers of propagules in the growth medium and roots in May and June. However, the irrigation water sampled in March and July did not contain recoverable propagules (data not shown). *Elaeagnus* did not exhibit chlorosis.

Table 1. Root isolation percentages for *Elaeagnus pungens* (silver thorn) and *Juniperus conferta* 'Blue Pacific' that received chlorinated (C) or nonchlorintated (N) irrigation water.

Species and time	*Pythium*		*Phytophthora*		*Rhizoctonia*	
	C	N	C	N	C	N
Elaeagnus						
March	12%	16%	9%	11%	64%	8%
April	15	13	1	3	13	37
May	7	20	1	—	6	25
June	16	5	1	5	2	3
July	15	5	14	15	—	—
August	9	—	0	50	0	17
Juniperus						
March	34	39	17	15	20	46
April	43	4	17	65	9	27
May	20	42	48	35	38	34
June	79	31	62	43	14	24
July	71	26	33	77	2	4
August	25	65	63	67	23	26

C = Chlorinated; N = Nonchlorinated
Chlorination began after the March sampling

Table 2. Number of propagules (*Pythium* and *Phytophthora*) in the growth medium of *Elaeagnus pungens* (silver thorn) and *Juniperus conferta* 'Blue Pacific'.

Time	*Elaeagnus*		*Juniperus*	
	C	N	C	N
March	284	101	280	235
April	1[illegible]	169	363	129
May	—	—	359	340
June	14	61	258	78
July	52	145	78	147
August	67	105	128	233

Growth medium samples were less than 1 19 mm
C = Chlorinated, N = Nonchlorinated
Chlorination began after the March sampling.

Leachate chloride levels for *Elaeagnus* in July, August, and September were 9.4, 9.2, and 6.0 ppm, respectively, for the chlorinated plants, and 10.2, 7.4, and 9.4, respectively, for the nonchlorinated plants. Leachate levels were presumed to be similar for 'Blue Pacific' juniper since plants were treated similarly. These leachate levels were probably not excessive in view of the research of Frink and Bugbee (3) in which a solution containing 18 ppm chloride did not result in a reduction in shoot dry weight for

16 of 23 species tested. Tissue chloride levels were generally similar for the chlorinated and nonchlorinated plants (Table 3) and no visual damage was noted.

Table 3. Leaf tissue chloride percentages for *Gardenia jasminoides, Hibiscus rosa-sinensis, Ilex cornuta* 'Dwarf Burford', *Juniperus chinensis* 'Parsonii' and *Podocarpus macrophyllus* that received chlorinated or nonchlorinated irrigation water Chlorination began after the March sampling.

Species	Chlorinated		Nonchlorinated	
	March	July	March	July
Gardenia	0 13%	0.12%	0 14%	0 14%
Hibiscus (green)	0.39	0 43	0.34	0.46
Hibiscus (variegated)	0 30	0 92	0.27	0.81
Ilex	0 12	0.17	0.12	0 17
Juniperus	0 16	0 17	0 19	0 21
Podocarpus	0 41	0.49	0 49	0 48

Our study indicated that 0.2 ppm free chlorine in reclaimed irrigation water did not effectively suppress root rot pathogens in the growth medium or roots of 'Blue Pacific' juniper. Although the efficacy is questionable based on data for *Elaeagnus*, higher rates of chlorine may be advantageous when disease pressure is high as was the case in the beginning of this study.

In another study conducted with greenhouse-grown *G. jasminoides* and *P. macrophyllus*, 1 and 10 ppm chloride applied weekly to the foliage resulted in minimal leaf chlorosis of *G. jasminoides*, with more chlorosis evident at 100 and 1000 ppm chloride. *P. macrophyllus* did not exhibit chlorosis. The pH of the 100 and 1000 ppm solutions was 9.5 and 10.5, respectively. A pH above 9.0 may suppress the biocidal activity of chlorine (2) and may have attributed to the chlorosis. The pH of pond and chlorinated irrigation water at Gramling Nursery was 7.0 and 6.8, respectively, in September.

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TECHNICAL SESSIONS

EASTERN REGION

Thirty-Ninth Annual Meeting

December 4-8, 1989

TORONTO, CANADA

TECHNICAL SESSIONS
Tuesday Morning, December 5, 1989

The thirty-ninth annual meeting of the Eastern Region of the International Plant Propagators' Society convened at 8:00 a.m. in the Concert Hall of the Royal York Hotel, Toronto, Canada.

PRESIDENT GRAHAM: On behalf of the Eastern Region and the Local Site Committee I wish you a very warm welcome to Toronto. Your Program Chairman, Peter Orum, this year has put together what I can only describe as an excellent program for our 39th annual meeting. The Local Site Committee under the able leadership of Joerg Leiss has worked hard to put together interesting tours. If you have any questions during the meeting please ask us for assistance. To start our meeting this morning we have Chris Andrews, Executive Director of the CNTA (Canadian Nursery Trade Association) to welcome us.

CHRIS ANDREWS: Ed. Note Mr. Andrews welcomed all in attendance on behalf of the CTNA and discussed the exciting things that are occuring in the nursery industry in Canada.

PRESIDENT GRAHAM: I will now turn the program over to Peter Orum, our Program Chairman.

PETER ORUM: It is indeed great to be back in Toronto even though it is a little on the cool side, however, I think it was that way 11 years ago. First of all, I would like to say thank you to those people who have made it possible for me to do my job this year, to speakers and moderators, and everyone else who have been very willing and cooperative in getting everything together for the meeting. We have tried this year to get everything divided into sections of somewhat similar things. The first section this morning will be on grafting and cuttings. Our moderator is Joerg Leiss.