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Quantification of Weed Seed Contamination and Weed Development in Container Nurseries[1]

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Abstract

An investigation was conducted at seven North Carolina nurseries to evaluate the possibility that container substrates serve as weed infestation sources. Container substrate treatments consisted of sand/pasteurized bark, bark/pasteurized sand, pasteurized bark/pasteurized sand, and bark/sand. No differences were observed between numbers of weed seedlings found in the four substrate combinations. Differences were observed across nursery sites and the nursery by date interactions. Five weed species most frequently observed were yellow woodsorrel (*Oxalis stricta* L.), hairy bittercress (*Cardamine hirsuta* L.), common groundsel (*Senecio vulgaris* L.), spotted spurge (*Euphorbia maculata* L.), and mouseear chickweed (*Cerastium vulgatum* L.).

Index words: weed introduction, weed seed dispersal, nursery media

Significance to the Nursery Industry

Weed control in the container nursery is essential if marketable plants are to be produced. A prerequisite in the weed control scheme is understanding the source and species of weeds that must be controlled. A knowledge of the life cycle of weeds is also necessary to develop effective weed control strategies. One theory among nursery growers is that a number of weeds found at the nursery are from bark and sand components of the potting mix. These data show that in selected nurseries, bark and sand components did not serve as major weed seed contributors, and emphasizes the importance of the immediate nursery environment as a source of weed problems.

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Introduction

Basic to weed management in container nurseries is an understanding of how weed seed enter and are dispersed through the nursery. Movement of weed seed into production areas may occur by wind, water, animals, humans (6) and infested crop seed (1). Turner (4) observed that dispersal occurred through both interregional long-distance and intraregional short-range dispersal. Interregional long-distance introductions related to human movement while intraregional short-range dispersal related to human activities, plant characteristics and environmental conditions.

Aldrich (1) rejected the significance of outside seed introduction and concluded that management programs should focus on the immediate environment including seed production. Limited research in the area of weed seed introduction to nurseries has been conducted. Conducting research designed to quantify and determine the relative importance of weed seed introduction in container nurseries, Williams and Sanders (5) examined the role of splashing, lateral dispersal, wind dispersal and dispersal by irrigation water.

Significant research exploring the introduction of weed seed through nursery substrates is deficient.

The objectives of this research were to determine if weed infestations in nursery containers are introduced through bark or sand substrates and to document the occurrence of specific weeds.

Materials and Methods

Weed seedling development was assessed in container experiments conducted at seven nursery sites in Eastern North Carolina during the period of October, 1988 through September, 1989. Slightly-aged pine bark (primarily loblolly plus southern yellow pine) and sand components from each nursery were collected, placed in tagged cotton bags, and returned to a central area for processing. Each component was pasteurized using steam in a Lindig cart for 30–45 minutes at 82° to 88°C (178°–190°F).

After pasteurization, bark and sand components were returned to respective nurseries and mixed with a cement mixer to produce a standard bark and sand nursery mix (3:1, v/v). Four bark and sand mixes were prepared: pasteurized bark plus nonpasteurized sand, nonpasteurized bark plus pasteurized sand, pasteurized bark plus pasteurized sand, and nonpasteurized bark plus nonpasteurized sand. Individual mixes were placed in color-coded pots for ease of identification.

The pots without an ornamental plant were placed in experimental container areas at each of seven nursery locations. Each area contained one gallon juniper or azalea plants which remained in place for a full year. The four treatments, consisting of 40 pots of each mix were placed in a completely randomized design using location as replication. The experimental areas were exposed to standard nursery practices except that no herbicides were applied to any of the pots included in the experiment.

All containers in the plots were hand-weeded at 30 day intervals and emerged weed seedlings in each pot were recorded. Unidentified weeds were allowed to mature and were identified, if possible, at later rating periods.

Results and Discussion

There were no significant differences in the four substrate treatments (Table 1). Weed seed introduction through substrate components accounted for only a minor part of the overall seed influx in these nurseries. The majority of weed introductions were apparently related to the immediate environment reinforcing the findings of Aldrich (1). Similar conclusions were also noted by Wilson (6) who concluded that seed production at individual field sites accounted for the largest introduction of seed into the soil seed bank.

Although efforts were made early in the nursery site selection process to eliminate variability in specific sites, there were significant differences among nurseries. Several nurseries were more weedy than others due to differences in weed control practices. Differences were further explained by proximity to weed seed sources and the potential for subsequent intraregional short-range dispersal (4) attributed to human activities or plant morphology. Major weed species in close proximity to nursery areas included spotted spurge, hairy bittercress, yellow woodsorrel and common groundsel. Based on the heavy infestation of these weeds at several nursery sites, an edge effect (1) could be used to explain the differences observed across nursery locations. An edge type effect is often used to characterize the diversity of species at the interaction of communities. In a nursery agroecosystem, wide unplanted weed infested areas between nursery plantings and alternative use areas generally increase the likelihood of dispersal of weed seed to nursery areas.

No differences were observed in weed counts across all dates, using the nursery by date interaction as the error term (Table 2). The lack of significant differences was most likely attributable to a constant influx of weed seed for nursery weeds into the containers over the evaluation period. The influx may be attributed to differences in the nurseries due to nearby weeds as discussed previously or by characteristics of successful weed invaders as described by Baker (2). Constant migration of weed seed would allow time for individual germination requirements to be met while creating a substantial seed reservoir.

After a full year, weeds of 24 genera in 14 families had been observed. Yellow woodsorrel, hairy bittercress, common groundsel, spotted spurge, and mouseear chickweed were the most frequently observed. The existence of a dominant, narrow weed spectrum verifies findings of Elmore (3) who generated a list of primary weeds in California container nurseries. He concluded that dominant weeds are area specific or introduced through wind dispersal. The dominant weed species recovered in our study satisfied many

Table 1. Effect of substrate pasteurization on weed seed germination at seven nursery sites in eastern North Carolina.

	Weed counts from a full year, 40 pots/treatment						
	Nursery site						
Treatment	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Sand/Pasteurized Bark[z]	200	50	18	20	17	42	23
Bark/Pasteurized Sand	161	39	52	25	10	71	19
Pasteurized Bark/Pasteurized Sand	83	101	39	32	26	58	16
Bark/Sand	203	68	75	29	23	70	47

Significance	(combined data − Pr > F)[y]
Nursery (N)	<u>0.0001</u>
Treatment (T)	0.3529
N × T	0.0814

[z]If not designated as pasteurized, media component is nonpasteurized.

[y]Nursery and Treatment were analyzed using the ANOVA MS for Nursery × Treatment as an error term; the Nursery × Treatment used the overall ANOVA MS. Significance of the F value is greater than 5% when underlined.

Table 2. Effect of time on weed seed germination at seven nursery sites in eastern North Carolina.

Nursery site	Weed counts from a full year, 160 pots/nursery site						
	Date						
	Feb. 03	Mar. 29	May 11	Jun. 09	Jul. 10	Aug. 10	Sep. 14
1	0	9	160	368	26	26	58
2	9	126	12	7	5	20	79
3	7	89	41	18	12	2	15
4	0	1	1	10	6	39	49
5	4	0	8	19	11	5	29
6	0	0	5	3	57	69	107
7	0	0	0	1	1	11	92

Significance	(combined data − Pr > F)[z]
Nursery (N)	0.0001
Date (D)	0.4813
N × D	0.0001

[z]Date was analyzed using the ANOVA MS for Nursery × Date as an error term, the Nursery × Date interaction used the overall ANOVA MS. Significance of F value is greater than 5% when underlined.

Table 3. Weed counts at seven nursery sites 74 days after final study evaluation.

Weed species	Weed counts, 160 pots/nursery site							
	Nursery site							
	1	2	3	4	5	6	7	Total
Oxalis stricta L.	64	0	3	23	116	122	0	328
Cardamine hirsuta L.	92	32	0	0	2	95	33	254
Senecio vulgaris L.	119	12	2	1	0	0	1	135
Euphorbia maculata L.	30	2	8	6	25	16	47	134
Cerastium vulgatum L.	21	1	4	6	38	7	27	104
Scleranthus annuus L.	54	0	26	0	0	0	12	92
Conyza canadensis (L.) Cronq.	38	5	23	3	3	0	1	73
Digitaria sanguinalis (L.) Scop.	2	0	0	33	2	2	0	39
Alopecurus spp.	24	0	0	2	8	1	0	35
Pinus spp.	1	1	4	1	11	11	0	29

characteristics of successful weed invaders, as noted by Baker (2) including adaptable germination requirements, rapid growth throughout the vegetative phase, continuous and abundant seed production with favorable conditions, and adaptations for short and long range dispersal. These characteristics likely enhanced spread in the immediate container environment. The presence of a few major weeds reinforced findings of our study suggesting primary introductions came from the immediate environment.

As a follow-up to this research, experimental containers were allowed to remain in place for approximately two months after the final evaluation period to further assess the effects of intraregional dispersal. Cumulative weed counts were then recorded for each of the weed species by nursery site. The ten most frequently observed weeds are listed in Table 3. Many of the species are high seed producers and have specialized structures for short and long range dissemination. Given their high reinfestation rates, it would be difficult to break the weed cycle with frequent hand weeding. Even with monthly weeding employed during the study, seedling counts were high, thus increasing the overall potential for reinfestation.

Our study suggests that steam pasteurization of substrate components failed to substantially reduce weed seed introductions at the selected nursery sites. This study reaffirms that there are a limited number of major weeds in a nursery and confirms the importance of the immediate environment in the continuation of weed problems. Additional emphasis should be directed to the control of weeds in adjacent nursery areas to avoid continual, season-long problems with weeds.

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