Controlling Rooting-Out of B&B Nursery Stock During Storage[1]

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Abstract

Cupric hydroxide formulated as Spin Out™ (7% $Cu(OH)_2$ in a latex carrier, w/w) was used to prevent rooting-out of *Taxus* x *media* Rehd. 'Densiformis' root balls into surrounding mulch or soil during storage over a four-month period. Treatments included: painting the bottom of the root ball with Spin Out™, setting the root ball on Spin Out™-treated burlap or on untreated burlap, and rewrapping the root ball with Spin Out™-treated burlap or burlapping using Spin Out™-treated burlap before mulching. All treatments provided some control of rooting-out after 12 to 16 weeks storage. The most effective treatments were 1) in unmulched situations, setting the root ball on Spin Out™-treated burlap (92% reduction in root count after 16 weeks), and 2) in mulched situations, either rewrapping or burlapping with Spin Out™-treated burlap (90% and 86% reduction in root count, respectively, after 16 weeks). Using Spin Out™-treated burlap to prevent rooting-out during storage can reduce the incidence of re-balling and root removal prior to shipping and planting stored B&B nursery stock.

Index words: root growth, nursery stock, cupric hydroxide, Spin Out™.

Species used in this study: yew (*Taxus* x *media* Rehd. 'Densiformis').

Significance to the Nursery Industry

The rooting-out of balled and burlapped (B&B) nursery stock stored more than a few months, particularly if that stock is mulched, is a familiar problem. Before moving rooted-out B&B stock, roots either must be removed or contained by burlapping (rewrapping). Preventing rooting-out of stored B&B nursery stock can also reduce the incidence of re-balling or root removal prior to planting, and should benefit rewholesalers, landscapers and retailers. This study demonstrated that Spin Out™-paint and Spin Out™-treated burlap effectively reduce rooting-out into the soil of the holding area, or into the mulch surrounding heeled-in plants, over a four-month storage period. The most effective treatments were, in unmulched situations, setting the root ball on Spin Out™-treated burlap, or in mulched situations, either rewrapping or burlapping with Spin Out™-treated burlap. Using copper-treated burlap allows the heeling-in of stock for extended periods without excessive rooting-out.

Introduction

Garden centers and nursery rewholesalers prefer container-grown plants because balled and burlapped (B&B) plants can be more difficult to maintain in good condition while being held in the nursery yard. By season's end, B&B stock typically roots out into the nursery yard soil. Moving rooted-out plants involves pulling up soil and/or mulch with the ball (Fig. 1a). This not only injures the root system, but also reduces consumer appeal.

The rooting-out of nursery stock during storage has received little attention in the literature, but is a problem familiar to anyone who has stored B&B material longer than a few months. Before moving rooted-out B&B stock, roots that have grown out during storage must either be contained by rewrapping, ie. covering the mulch that contains roots with another layer of burlap and twine, or severed.

Drying of exposed roots can quickly impair subsequent plant growth or survival (3), while rewrapping is undesirable because it adds weight and bulk to the ball, and requires more handling at planting to remove the extra burlap and twine. Severing escaped roots is likely to increase transplant shock, which may already be a limiting factor in plant establishment (6, 10, 12). Watson (13) found that most new root growth originates from the ends of roots cut during digging. Since these lie just inside the burlap of a B&B ball, it is likely that new roots growing through the burlap represent most of the new root mass. The removal of this new root growth may further reduce plant vigor, increase plant stress following transplanting and slow plant establishment in the landscape. Avoiding either rewrapping or root pruning should allow longer term storage of B&B stock and benefit B&B nursery stock producers.

The use of copper to control root growth is well established in the nursery industry in the form of copper treated grow bags, copper painted pots, and pot-in-pot production (8, 11). However, neither copper paint nor copper-treated fabrics have been used to control the growth of roots from B&B stock. Copper is routinely used at concentrations of 0.5 to 1% (cupric sulfate, cupric napthenate or cupric ammonium carbonate) to retard burlap deterioration. In a study of copper-treated burlap, Kuhns and Sydnor (5) observed that high concentrations of cupric sulfate ($CuSO_4$; ≥ 0.8%) inhibited the growth of cotoneaster roots through the treated burlap.

Rooting-out has been addressed recently in regards to pot-in-pot production systems, where root growth from the planted container through the drain holes of the holder pot and into the surrounding soil represents a serious harvesting problem (7). Using Spin Out™-treated fabric bags as the

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Fig. 1. Root growth from soil balls of 'Densiformis' yew after 16 weeks: (a) unmulched control; (b) mulched control; (c) unmulched ball set on copper-treated burlap; (d) mulched ball rewrapped with copper-treated burlap.

planted container has worked well to control rooting-out in these systems (8).

The objective of this study was to improve the storage quality of B&B stock by using copper-paint and copper-treated burlap to prevent the plant from rooting-out into the soil of the holding area or into mulch surrounding the root ball. The possibility also exists that controlling root growth in the ball could increase the branching and density of the root system within the ball (11), producing a ball that would hold together better and transplant with more success. Yew was chosen for this study because it is an important field crop in Rhode Island, and because both *Taxus* x *media* Rehd. 'Densiformis' and *T.* x *media* 'Hicksii' have been root pruned effectively by Spin Out™ in containers (4).

Materials and Methods

In May 1995, 120 *Taxus* x *media* 'Densiformis' (field-grown in a Newport silt loam; plant size 15–18 in (38–46 cm); Rhode Island Nurseries, Inc., Middletown, RI) were balled and burlapped with standard coarse burlap (7 oz. untreated, Dayton Bag and Burlap, Dayton, OH). Another 20 plants were burlapped at the same time with standard coarse burlap painted on both sides with 7% (w/w) cupric hydroxide in a latex carrier (Spin Out™; Griffin Co., Valdosta, GA) to an average final concentration of 3.12 μg Cu/cm^2. Shoots were not pruned. Plants were held in Kingston, RI, on a gravel bed covered ~10 cm (4 in) deep with softwood sawdust (JNL Sawdust Inc., Wichindon, MA). Sixty plants were covered to the top of the ball with additional sawdust to simulate heeling-in. Plants were irrigated by overhead sprinklers for one hour every other day or as needed. No supplemental fertilization was used.

Seven treatments were evaluated: 1) unmulched plants on sawdust (unmulched control), 2) unmulched plants set on sawdust with the bottom of the ball painted [~20–25 cm (8–10 in) diameter area] with Spin Out™, 3) unmulched plants set on a 30 × 30 cm (12 × 12 in) square of standard copper-treated burlap (0.7% cupric ammonium carbonate; Specialty

Table 1. **Influence of rooting-out control strategies on growth of roots of 'Densiformis' yew outside the ball[z] in a B&B production system over a 16-week period.**

	Root dry wgt. (g)				Root count				Root length (mm)		Root area (cm2)	
Treatment number and description	**4 wks**	**8 wks**	**12 wks**	**16 wks**	**4 wks**	**8 wks**	**12 wks**	**16 wks**	**4 wks**	**8 wks**	**12 wks**	**16 wks**
1. Control, no mulch	0	0.3	3.5	11.4	0.2	42	198	380	3	1129	174	485
2. Copper-painted ball, no mulch	0	0.1	0.7	2.3	0.2	16	23	83	6	290	27	96
3. On untreated burlap, no mulch	0	0.4	1.1	4.3	0.4	45	98	232	1	1368	58	189
4. On copper-treated burlap, no mulch	0	0	0.2	0.9	0	4	13	29	0	51	10	39
5. Control, mulched	0.2	2	13.1	33.2	12.4	232	645	711	200	8907	722	940
6. Wrapped in copper-treated burlap, mulched	0.1	0.1	1.2	5.5	8.8	23	41	71	86	627	66	168
7. B&B in copper-treated burlap, mulched	0	0.1	2.9	6.4	2.8	18	67	97	40	557	263	171
Treatement significance[y]												
Within harvest	**	***	***	***	**	***	***	***	**	**	***	***
Linear contrasts												
Mulched vs. no mulch (5 vs. 1)	**	***	***	***	***	***	***	***	**	***	***	***
Cu-painted ball vs. control, no mulch (2 vs. 1)	ns	ns	*	**	ns	ns	***	***	ns	ns	*	**
Plain burlap vs. control, no mulch (3 vs. 1)	ns	ns	*	*	ns	ns	**	**	ns	ns	*	*
Cu-burlap vs. control, no mulch (4 vs. 1)	ns	ns	**	***	ns	ns	***	***	ns	ns	**	***
Cu burlap vs. plain burlap, no mulch (4 vs. 3)	ns	ns	ns	ns	ns	ns	*	***	ns	ns	ns	ns
Rewrapped ball vs. control, mulched (6 vs. 5)	*	***	***	***	ns	***	***	***	*	***	***	***
Cu B&B vs. control, mulched (7 vs. 5)	*	***	***	***	**	***	***	***	**	***	***	***
Rewrapped ball vs. Cu B&B, mulched (6 vs. 7)	ns	ns	ns	ns	*	ns	ns	ns	ns	ns	ns	ns

[z]Root growth outside of ball (no additional burlap) or outside additional burlap treatments. Root growth between ball and additional burlap reported in text.
[y]***, **, *, ns—significant at $p \le 0.001$, 0.01, 0.05, or not significant, respectively.

Converting, Nashville, GA), 4) unmulched plants set on a 30 × 30 cm (12 × 12 in) square of Spin Out™-treated burlap, 5) mulched plants (mulched control), 6) mulched plants rewrapped with a 91 cm × 91 cm (36 × 36 in) square of Spin Out™-treated burlap over the original burlap, and 7) mulched plants burlapped in the field with Spin Out™-treated burlap.

The experiment was designed as a randomized complete block with five replicate plants per treatment, seven treatments (4 unmulched, 3 mulched) and four harvest dates (blocks). Plants were harvested every four weeks for 16 weeks to assess plant growth and rooting-out. At each harvest a shoot growth index was determined as (height + width1 + width2) / 3. Shoots were dried at 70C (158F) for one week and weighed.

Roots inside and outside the burlap treatments were counted, washed free of sawdust and total root length (first and second harvest) or root area (third and fourth harvest) determined (LI-3100 leaf area meter, LI-COR, Inc., Lincoln, NE). Root weights were recorded after drying at 70C (158F) for 36 hours. Following removal of the original or treated burlap the root balls were washed free of soil, and fine roots (measuring < 2 mm) were separated from coarse roots, dried and weighed. Data were analyzed using the general linear model procedure of SAS (9) and treatments compared using linear contrasts.

Results and Discussion

Throughout the study, no symptoms of copper toxicity, nor other abnormalities, were observed in leaves or shoots of 'Densiformis' yew. Shoot growth index, dry weight and height did not differ among treatments over the course of the study (data not shown). Shoot growth index increased from 52.9 cm (20.8 in) after four weeks to 57.8 cm (22.8 in) at the end of the study. In the same period shoot height increased from 47 to 51 cm (18.5 to 20.1 in). Shoot dry weight increased from 1,046 g to 1,253 g (2.3 to 2.8 lb). Coarse root dry weight increased from 233 g to 278 g (8.2 to 9.8 oz) over the study, with no differences among treatments. Fine root dry weight inside the ball also increased, from 43 g to 133 g (1.5 to 4.7 oz), without being affected by treatments. Arnold and Struve (2) reported that growing several woody species in $Cu(OH)_2$-treated containers did not affect shoot or root dry matter accumulation.

The mass, number and length of roots growing out of unmulched root balls increased sharply between 8 and 16 weeks (Table 1, Fig. 1a). Significant control of roots in unmulched treatments by copper was not evident before 12 weeks, though the painted ball and treated burlap square treatments reduced root number from 42 (control) to 16 and 4 roots, respectively, after 8 weeks. After 12 and 16 weeks, however, all root control treatments reduced root mass and number compared to the control, including standard copper-treated burlap.

The mass, number and length (or area) of roots growing inside copper-treated burlap (treatments 3, 4 and 6) were recorded at each harvest (data not shown). Equivalent amounts of root were found between the ball and squares of standard or copper-treated burlap in unmulched treatments. An average of 39, 71 and 255 roots were present after 8, 12 and 16 weeks, respectively. Mulched root balls yielded 201, 314 and 362 roots between the ball and copper-treated burlap wrap over the same period. Roots of yew which encountered copper-treated burlap exhibited typical symptoms of copper toxicity: cessation of elongation, radial thickening and red coloration of the distal 1 mm or so of the root (1).

Though relatively impractical, painting the bottom of the root ball reduced rooting-out by 80% after 16 weeks, compared to unmulched controls (Table 1). Setting the root ball on copper-treated burlap provided the best control (>90% reduction in rooting-out) of all the unmulched treatments (Fig. 1c). Roots which escaped through copper-treated burlap grew through holes in the burlap resulting from the looseness of the weave or where cut roots protruded through the burlap. Once outside the treated burlap, roots resumed normal growth.

Mulching greatly increased the number and mass of roots found outside the root ball at each harvest (Table 1, Fig. 1b). The greatest amount of rooting-out occurred on mulched plants with no control measures in place. After 16 weeks these balls averaged 711 roots each, with root area averaging 940 cm^2. This amount of roots represented 33.2 g dry weight, or about 6.4% of the total root dry mass (517 g). This outside root mass was entirely represented by small (< 2 mm) diameter roots that regenerated from coarse roots within the ball. Significant control of root mass, root number and root area in mulched treatments was apparent at all four harvest dates. Rewrapping (Fig. 1d) or burlapping with treated burlap provided equivalent control for mulched plants. Rewrapping might be the preferred method of root control since the copper-treated wrap could be removed before shipping. Spin Out™-treated and synthetic burlap should be removed during planting because they will not rot, and might hinder plant establishment or long term root health (13).

In conclusion, the use of copper-treated burlap prevents rooting-out of B&B nursery stock during storage, thereby reducing the incidence of re-balling and root removal prior to planting. This use of copper should significantly benefit re-wholesalers, landscapers and retailers who wish to avoid rooting-out of nursery stock.

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