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BRIEF ORIGINAL

Metal accumulation in root crops grown in planters constructed from copper azole treated lumber

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Abstract Preservative treated wood is often used to construct planters, but there are concerns about components migrating from the wood into the surrounding soil where they might be selectively absorbed by plants. Potential for selective accumulation was evaluated by growing radishes, carrots and potatoes in copper azole (CA) treated Douglas-fir planters. Copper levels were higher in soil adjacent to CA treated wood, but did not differ in roots or tubers grown in treated or non-treated wood. Copper levels were elevated in carrot foliage which is not normally consumed.

1 Introduction

Preservative treatments must have a certain degree of water mobility so they can interact with and limit attack by wood destroying organisms. Water solubility is of little concern in most applications because the preservative migrates only a short distance with little effect on the environment (Stilwell and Gorny 1997; Morrell et al. 2003). One area where treated wood use has raised concerns, however, is in vegetable gardens where metals migrating from the wood might be preferentially absorbed by plants. A number of studies have shown that there is little risk associated with growing plants near wood treated with the metal based preservatives chromated copper arsenate (CCA) or alkaline copper quaternary compound (ACQ) (Jin and Preston 1994; Levi et al. 1974; Stilwell and Graetz 2001). Copper azole (CA) has replaced CCA in residential applications, but there have been few studies on the potential for plants to selectively absorb the copper in CA. This report describes trials with root crops grown in raised beds constructed with or without CA-treated wood.

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2 Materials and methods

Douglas-fir (*Pseudotsuga menziesii*) lumber (nominally 50 × 150 mm × 2.4 m long) either non-treated or treated with CA according to the American Wood Protection Association Use Category 3B (American Wood Protection Association 2012) was used to construct 300 mm wide × 600 mm long rectangular frames. A similarly-sized piece of 3 mil thick black polyethylene was attached to the bottom of each frame and then covered with a 300 mm × 600 mm piece of non-treated oriented strand board (OSB) All connections were made using galvanized metal fasteners. These boxes allowed metals to migrate from the treated wood to interact with the surrounding soil while minimizing soil loss through the planter bottom. Vigoro All Purpose Potting Mix (Swiss Farm Products, Las Vegas, NV) was added to within 25 mm of the planter top, then seeds or tubers were planted at the recommended depth. Seeds were planted immediately adjacent to the treated wood (edge) or at the center of the bin (center). Tubers were only planted at the center. Carrots (*Daucus carotus* subsp. *sativa,* Variety: Mokum), radish (*Raphanus sativus*, Variety: Cherry Belle) and red potatoes (*Solanum tuberosum*, Variety: unknown) were evaluated.

Containers were exposed in an area that received full sun and regularly watered over a 3 month period. Then foliage was separated from the root or tuber. Material from a given location/planter was thoroughly washed in distilled water to remove all soil, then air dried for 4 h before being

Table 1 Copper levels in foliage or roots/tubers of plants grown in containers constructed using non-treated or copper azole (CA) treated Douglas-fir lumber

Plant	Copper content (μg/g oven dried plant material)[a]							
	Roots/tuber				Foliage			
	Non-treated		CA treated		Non-treated		CA treated	
	Edge	Center	Edge	Center	Edge	Center	Edge	Center
Carrot	16.2 (11.0)	16.1 (5.3)	15.3 (1.6)	16.0 (0.6)	46 (22.0)	45.4 (24.5)	133.5 (7.2)	88.1 (45.6)
Radish	14.2	14.0	14.1	17.7	59.5	67.5	63.3	56.0
Potato	–	13.9 (0.8)	–	16.7 (1.7)	–	91.0 (29.7)	–	84.5 (58.0)

[a] Values represent means of three replicates except for the radish where only one composite sample was tested. Figures in parentheses represent one standard deviation. Potato tuber locations were not differentiated in the planters

oven dried (103 °C) and ground to pass a 20 mesh screen. This material was acid digested and this extract was analyzed for copper by ion coupled plasma spectroscopy (ICP). Soil samples removed from the edges and center of each planter were similarly digested and analyzed for copper content by ICP. In general, three samples were analyzed per plant material; however, only one analysis was performed for each radish growing condition.

3 Results and discussion

Soil copper levels in non-treated planters were similar at the center and edge (4.9 vs 3.8 μg Cu/g soil), regardless of crop as were those from the centers of CA boxes (4.1 μg/g); however, levels were over six times higher in soils removed from the edges of CA boxes. The results are consistent with previous studies showing that metal components migrate short distances from treated wood and were not abnormally higher for soils (Morrell et al. 2003).

While elevated soil copper levels might be a concern, a more important parameter would be copper in the plants. Copper levels in carrot or radish roots and potato tubers differed little between treated and non-treated planters even when adjacent to the wood (Table 1). There was no evidence of selective copper concentration in the edible portions of the plants.

Although the foliage of the crops tested is not normally eaten, copper levels in foliage from radishes and potatoes were similar for plants grown in treated and non-treated planters indicating no selective copper absorption by foliage. Copper levels in carrot foliage, however, were nearly three-fold higher in plants grown near the treated planter edges than in those grown in non-treated planters and nearly twice that level at the planter centers. These results suggest that carrot foliage selectively sorbed and concentrated copper. Hyper-metal accumulation is a common plant phenomenon and carrots have been reported to accumulate arsenic from contaminated soils (Singh and Ma 2007).

4 Conclusion

Copper migrated from CA treated wood, but this did not result in increased copper in edible portions of the crops tested. These results are consistent with previous studies of CCA treated wood and suggest that using treated wood in gardens poses little risk of increasing metal levels in the resulting crops. Where users are concerned, most are advised to line the planter interior with polyethylene. While this is a prudent measure, the results indicate that it is not entirely necessary.

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