Changes in Root Length and Diameter in Plants Grown in Copper-Treated Containers

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INTRODUCTION

Copper products have been successfully used to control root growth and development in container grown woody landscape plants for several years. Nurseries apply a solution of copper in latex paint to inner surfaces of containers for increased root control enabling improved field establishment and performance of woody landscape plants (Struve, 1993). Copper products control roots by eliminating circling in containers, forcing roots to branch to the center of the container (Arnold and Struve, 1989). The resulting root system is more compact and evenly distributed throughout the container. Increased shoot growth and development after transplanting has also been reported in several plant species produced in copper-treated containers (Arnold and Struve, 1989). In the past, researchers have relied upon gravimetric measurements to evaluate root systems. Observation of roots exclusively by root dry weight can provide misleading information due to differences in allocation of root biomass in production of large and small roots. Observation of root systems with the aid of computer imaging and analysis software (MacRhizo^{TM}, Regent Inc.) provides an improved method of observing and evaluating root systems. The objective of this study is to determine how copper treatment modifies total root length and root diameter of plants grown in containers.

MATERIALS AND METHODS

A fine-rooted species, redbud (*Cercis canadensis*), and a greenhouse species utilized for rapid growth, marigold (*Tagetes patula* 'Little Devil Flame') were grown in 12 cm containers. Container walls were untreated or treated with Spin Out^{TM} (Griffen Corp., Valdosta, GA, USA) a form of cupric hydroxide in latex paint. Marigold seeds were sown directly into containers and redbud were sown into Metro Mix 360 (Scott's) in large flats (60 cm × 30 cm × 10 cm), and transplanted to containers once seedlings reached 2 in. Overhead irrigation was applied as needed with Peter's 15N-$5P_2O_5$-$15K_2O$ fertilizer in solution at 200 ppm. Plants were grown under standard greenhouse conditions.

Root length and root diameter classes were obtained from a random 2.5 cm × 2.5 cm × 6.5 cm section of the root system. Marigold plants were evaluated after 38 days, once four to five flower buds were visible and beginning to open. Redbud were evaluated after 114 days, once treatment effects were observed in the root system. This experiment was repeated as a time course with marigold and was evaluated on 30, 35, and 40 days.

RESULTS AND DISCUSSION

No differences in root biomass were observed between treatments of copper and no copper, however, copper treatment effectively increased total root length in the

Table 1. Leaf area, shoot and root dry weight, and root length per root class of redbud and marigold 'Little Devil Flame' plants grown in 12-cm containers treated and untreated with copper hydroxide.

Species	Leaf area (cm^2)	Shoot dry wt (g)	Root dry wt (g)	Root length per root class treatment		
				0 - 0.5 mm	0.5 - 1 mm	>1 mm
Redbud						
Control	793.7	7.3	2.4	269.29	108.63	63.49
Copper	925.3	9.0	2.5	388.44	146.78	79.30
Marigold						
Control	490.15	2.5	0.8	348.30	312.99	259.53
Copper	517.99	2.8	0.8	426.32	361.02	246.94

sampled wedge of redbud and marigold by 28% and 11%, respectively. There was a significant increase in root length in the smallest diameter root class (0 - 0.50 mm) and the subsequent root diameter classes (0.50 - 1 mm and >1 mm) in both redbud and marigold when grown in copper-treated containers. MacRhizo™ enabled us to observe differences in roots from treated and nontreated copper containers that were not detected by measuring root dry weight. Shoot dry weight and leaf area of redbud and marigold were larger when subjected to copper treatments. In redbud, the leaf area and shoot dry weight increased by 14%. The results were less dramatic in marigold with only 5% and 13% increases in leaf area and shoot dry weight. These results suggest increased shoot development occurs as a result of better root development. A root system comprised of a greater proportion of small diameter roots results in increased water and nutrient uptake (Atkinson, 1980). Similar results were obtained when this experiment was repeated as a time course, evaluated at 30, 35 and 40 days for marigold. Again, no differences were observed in root dry weight but an increased amount of 0 - 0.50 mm diameter roots were observed in the copper treatment.

LITERATURE CITED

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