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# Influence of Sulfometuron Methyl on American Chestnut Seedling Growth and Leaf Function

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ABSTRACT

The expected production, dissemination, and planting of blight-resistant hybrid chestnut seedlings calls for anticipatory studies to establish optimal management practices. To test phytotoxic potential of a site preparation herbicide, seedling growth and physiological function were measured for potted American chestnut (*Castanea dentata* [Marsh.] Borkh.). Six concentrations (0.0, 0.026, 0.053, 0.105, 0.158, and 0.210 kg active ingredient [ai] $ha^{-1}$) of sulfometuron methyl (Oust) were applied to pots in April 2008, which were planted with 1 + 0 seedlings in May, and grown until November 2008. Changes in height, rootcollar diameter, and root volume and length were measured. A portable photosynthesis system was used to measure net photosynthesis, stomatal conductance, and transpiration. Seedlings treated with label-recommended doses (0.105–0.210 kg [ai] $ha^{-1}$) showed growth and leaf function suppression, including 55, 71, and 82% reductions in height growth, root volume, and net photosynthesis, respectively. These results indicate that a strong need exists for field trials, with various dose regimes, to be conducted to refine an application rate that minimizes phytotoxic damage while still providing suitable control of competition vegetation.

**Keywords:** American chestnut, herbicide, phytotoxic, restoration, site preparation

The introduction of chestnut blight (*Cryphonectaria parasitica* [Murr.] Barr) in the early 1900s resulted in the demise of American chestnut (*Castanea dentata* [Marsh.] Borkh.) (Paillet 2002), historically a dominant component of eastern US forests (Joesting et al. 2009). Ecologically and economically important prior to the blight epidemic (Pierson et al. 2007), the species is now primarily reduced to short-lived stump sprouts (Paillet 2002). Loss of this important species has not gone uncontested, and efforts on several fronts have sought to reestablish American chestnut. Currently, a promising restoration effort is directed toward incorporating resistance genes from Chinese chestnut (*Castanea mollissima* Blume) into American chestnut using backcross breeding (Diskin et al. 2006, Hiremath et al. 2007, Jacobs 2007).

In anticipation of a widespread planting effort, development of silvicultural practices for chestnut is prudent (Jacobs 2007). Little is known of the response of this species to site preparation and release treatments (McCament and McCarthy 2005), although recent studies suggest that the best growth is under conditions of high light and low competition (McNab 2003, McCament and McCarthy 2005, Anagnostakis 2007). Jacobs (2007) suggests that most future plantings will likely occur as afforestation of abandoned or marginal agricultural land and as an additional component of managed woodlands and plantations. The importance of weed control in such instances suggests the use of herbicide is likely in these plantations (Selig et al. 2005).

One herbicide frequently used in vegetation control is sulfometuron-methyl (methyl 2-[[[[(4,6-dimethyl-2-pyrimidinyl) amino]-carbonyl]amino]sulfonyl]benzoate) (Oust and Oust XP, hereafter referred to as sulfometuron). Sulfometuron is relatively broad spectrum and is effective at very low doses (Oust label recommends 0.105–0.212 kg active ingredient [ai] $ha^{-1}$ [DuPont 2003]). The active ingredient inhibits normal apical growth, especially root apices (Blair and Martin 1988, Barnes et al. 1990, Ware and Whitacre 2004). After application, sulfometuron remains soil active and has relatively low soil mobility (Russell et al. 2002), which results in continued growth suppression. If sulfometuron is used to treat chestnut planting sites, the potential exists for phytotoxic damage to seedlings. Several studies suggest phytotoxicity to seedlings of other crop species. Tolerance to sulfometuron is species-specific. Eastern hardwoods such as white ash (*Fraxinus americana* L.) and black cherry (*Prunus serotina* Ehrh.) appear to be sensitive, whereas red maple (*Acer rubrum* L.) appears relatively resistant (Horsley 1988). Investigation of the relationship between American chestnut growth and sulfometuron application is restricted to a single study conducted by Selig et al. (2005), who compared different herbicides and concentrations, for seedling height growth; however, results were unclear.

A better understanding of the relationship between chestnut seedling growth and sulfometuron is needed to refine use practices and ensure timely seedling establishment. Therefore, we conducted a potted seedling trial to assess the effects of six rates of sulfometuron on American chestnut seedling growth and leaf function. The intent of this trial was to quantify potential sulfometuron phytotoxicity to chestnut seedlings while controlling residue-degrading variables and the confounding effect of competing vegetation. Our objectives were to (1) determine the effect of differing sulfometuron rates on

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This article uses metric units; the applicable conversion factors are: meters (m): 1 m = 3.3 ft; hectares (ha): 1 ha = 2.47 ac; kilograms (kg): 1 kg = 2.2 lb.