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Results from six *Pinus taeda* nursery trials with the herbicide pendimethalin in the USA

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Pendimethalin is used by some nursery managers to control weeds in *Eucalyptus* and *Pinus* seedbeds and cutting beds of *Pinus*. Six trials were implemented in open-rooted seedbeds to test the response of *Pinus taeda* to postemergence (to the crop) applications of 2.2 kg ha⁻¹ active ingredient of pendimethalin (the formulation contained 455 g l⁻¹). No stunting was noticed when treating seedlings with 2.2 kg ha⁻¹ four to 10 weeks after sowing. In one study, treated seedlings were larger than those not treated. Although the 2.2 kg ha⁻¹ rate provided good control of the prostrate weed *Chamaesyce maculata*, pine seedlings developed herbicide galls on the stem near the groundline. The frequency of herbicide galls at 2.2 kg ha⁻¹ varied by study and ranged from 0 to 28%. At present, it is not known if the frequency of gall formation depends on environmental or genetic differences.

Keywords: dinitroaniline, herbicide galls, loblolly pine, nursery, phytotoxicity

Introduction

To ensure effective weed control in open-root nurseries, it is important to have effective alternatives in case preferred herbicides or soil fumigants are withdrawn from the market. It may also be important not to rely too much on one family of herbicides, especially if weeding is lax and weeds are allowed to reproduce prior to removal. For example, after the introduction of effective diphenylether herbicides, weed populations in seedbeds declined and this allowed more sunlight to reach prostrate annual weeds such as *Chamaesyce maculata* (prostrate spurge). This weed is now considered troublesome at several nurseries that rely heavily on controlling annual weeds with diphenylether herbicides.

Pendimethalin (*N*-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine) is a selective herbicide in the dinitroaniline family of herbicides with some activity on spurge (Gallitano and Skroch 1993). The chemical is absorbed through the roots and leaves of susceptible plants during germination and inhibits cell division and cell elongation. It has activity on several grasses and broadleaf weeds and is used in container nurseries in the USA (Riley et al. 1994) and in forest plantations (Woeste et al. 2005, Willoughby et al. 2009). An emulsifiable concentrate formulation of pendimethalin is labelled for use in forest tree nurseries in Australia, New Zealand and the United Kingdom. One label in New Zealand indicates that *Pinus radiata* may be treated 6–8 weeks after crop emergence with 0.99–1.3 kg ha⁻¹ (n.b. all herbicide rates reported in this paper involve only the active ingredient). However, this label also indicates that seedbeds should be treated only when seed are covered with at least 0.3 cm of soil. Other species labelled for use in New Zealand include *Eucalyptus*

(*E. botryoides*, *E. fastigata*, *E. globulus* and *E. saligna*), *Acacia* (*A. decurrens*, *A. mearnsii* and *A. dealbata*) and *Cupressus macrocarpa*.

Prostrate spurge (Euphorbiaceae) is a summer annual, native to North America (Krueger and Shaner 1982), but can now be found in a number of countries including Australia, Japan, Germany and Portugal. It can be a resilient weed in both container (Gallitano and Skroch 1993) and open-rooted nurseries and in some situations populations are high enough to stunt seedling growth. Oxyfluorfen (2-chloro- α,α,α -trifluoro-*p*-tolyl 3-ethoxy-4-nitrophenyl ether) provides some level of preemergence control (Ruter and Glaze 1992) but once spurge germinates and becomes established it is difficult to control with postemergence applications of oxyfluorfen. Spurge not controlled by oxyfluorfen can produce copious amounts of seed. Some labels for metsulfuron methyl (methyl 2-[[[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)amino]carbonyl]amino]sulfonyl]benzoate) include prostrate spurge but stunting can result if too much of this herbicide is applied, especially when seedlings are less than eight weeks old. Nursery managers need a cost-effective method of controlling prostrate spurge without stunting seedlings. The objective of this research was to determine if pendimethalin could be used in pine nurseries without injuring seedlings.

Materials and methods

During 2007 and 2008, herbicide experiments were conducted at four forest nurseries in three states (Table 1). Herbicide plots (1.5 m × 3 m) were arranged in a randomised