Auburn University
Southern Forest Nursery
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RESEARCH REPORT 16-05

EFFECT OF SOIL TYPES AND TEMPERATURE OF PENDULUM® AQUACAP™ APPLICATIONS ON GALL FORMATION IN CONTAINER-GROWN LOBLOLLY PINE SEEDLINGS

by
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INTRODUCTION

As trials of Pendulum® Aquacap™ were being conducted by the SFNMC for control of prostrate spurge (*Chamaesyce maculate*), the occasional appearance of stem galls on pine seedlings treated with PAC at multiple nurseries became a concern as presence of galls may affect seedling marketability. Eventually, further SFNMC studies showed that the timing of PAC application plays a major role in herbicide gall formation and the SFNMC recommended that PAC be applied **at the time of sowing**. Early studies (Research Reports 09-01; 10-04; 11-05) considered factors such as genetics, soil type, temperature or use of pine bark mulch to explain why galls formed at some nurseries but did not occur in similar PAC applications at other nurseries. Although genetics determine a plant's tolerance or susceptibility to herbicides, little is known about the specific herbicide tolerance of common pine species found in southeastern forest-tree nurseries (South and Hill, 2009). In hardwood production systems, the tolerance of seedlings to PAC is species-dependent (Research Reports 13-03; 13-05). Because little genetic information is available on herbicide tolerance in pines, the more attainable examination of the soil type x temperature interaction could possibly provide answers to the question of variations in gall formation observed. Therefore, the objective of this trial was to evaluate the formation of galls on seedlings when sown into two soil types in a greenhouse that kept the temperature factor (both soil types exposed to the same conditions) and treated with PAC 6 weeks after sowing.

METHODOLOGY

To assess the effect of soil type and temperature interaction of post-sowing applications of Pendulum® Aquacap™ on the formation of herbicide galls, soil was collected from Arborgen's Supertree Nursery near Shellman, GA and Weyerhaeuser's Pine Hill Nursery near Camden, AL. Shellman soil type was a sand (91:8:1) with a soil pH of 5.5 and organic matter content of 1.1%. In comparison, Camden soil type was a sandy loam (68:18:14) with a pH of 4.8 and organic matter content of 1.3. The study was installed in the SFNMC greenhouse in Auburn to control differences in temperature that may explain gall formation. One-gallon pots containing either a fine-textured (more clay) soil or a coarse-textured (more sand) soil were sown with 10 loblolly seeds each. In order to induce herbicide gall formation, one-third of pots of each soil type received an application of the low rate of PAC (34 oz/ac) and one-third received an application of the high rate (68 oz/ac) at six weeks post-sowing. The remaining untreated pots were designated as control

pots. The herbicide treatments were applied by AU Nursery Cooperative personnel with a CO_2 hand sprayer calibrated to broadcast a spray volume of 25 gallons per acre. After treatment, pots were randomly arranged on benches in the greenhouse by soil type (see Figure 1). Each treatment was one pot replicated 156 times. The experimental unit was the seedlings in one pot. Seven months later, in January 2015, counts of total seedlings and seedlings with stem galls were recorded by pot to determine soil type effect on herbicide-induced gall formation.

RESULTS AND DISCUSSION

These trials indicate that soil type has more of an effect on the formation of galls than temperature. Higher rates induced more galls in the sandy soil over those seedlings grown in the heavier soils. This is in sharp contrast with what has been observed in the field trials that used PAC. In an article published in *Weed Science* (Zimdahl et al 1984) on the degradation of pendimethalin (the active ingredient in PAC), it was reported that the influence of soil type is small when studies are performed at the same temperature and soil moisture. Soil types of clay, clay loam and sandy loam were used in the study. No soil with as high a percentage of sand as the Shellman soil used in this trial was included. Information on the mobility of pendimethalin in the Herbicide Handbook (Weed Science of America 2007) states that the herbicide strongly adsorbs to soil organic matter and clay and does not leach through the soil, so that those soils with a higher clay or organic matter content may have a longer persistence of pendimethalin than in sandier soils. Anecdotal evidence from SFNMC cooperating nursery managers shows that herbicide-induced gall formation after PAC application is higher in heavier (more clay) soils than in more sandy soils. However, this greenhouse trial showed that at the low rate (34 oz/ac) of PAC, there were no differences in the percentage of galls in the fine (clay) soil when compared to the coarse (sand) soil (Table 1). Unexpectedly, statistically significant differences were seen at the high rate of PAC (68 oz/ac) in the two soil types, with the coarse (sand) soil having a higher percentage of galls than the fine (clay) soil type. Because of this finding along with the results of no differences at the low rate, this study is inconclusive and our hypothesis for gall formation at the high rate may be due to genetics, soil types, temperature and their interactions. As reported in previous SFNMC studies (Research Reports 10-04; 12-01; 14-03), the application of Pendulum® Aquacap™ **after the time of sowing** may cause herbicide galls to form. The higher rate of PAC (64 oz/ac) in either soil type significantly increases the percentage of galls when compared to the low rate (34 oz/ac) of application. To avoid gall formation, it is best to use the lower rate as the time of sowing.

MANAGEMENT IMPLICATIONS

- In both fine and coarse soil types, the application of PAC at 34 oz/ac or 68 oz/ac at 6 weeks post sowing will result in the formation of herbicide galls on loblolly pine stems. This was expected and not surprisingly, higher rates produced significantly more galls than lower rates.

- When applied at the lower rate (34 oz/ac), the soil type had little effect on herbicide gall formation when temperature is held constant (the same) for both soil types.

- It is recommended that Pendulum® Aquacap™ be applied **at the time of sowing** to avoid herbicide gall formation.

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Table 1. Average percent galls[1] per treatment (pot) on container loblolly pine seedlings treated with Pendulum® AquaCap™, SFNMC Greenhouse, Auburn, AL.

Rate	Soil Type	
	Fine	Coarse
Check	0.0 a	0.0 a
Low	39.3 b	51.5 b
High	80.9 c	93.4 d

Different letters (a, b) within a seedling characteristic column indicate significant treatment difference in rates according to Duncan's Multiple Range test at alpha = 0.05. Underlined means within a seedling characteristic indicate significant treatment difference from that of the non-treated Check at that rate according to Dunnett's T-test at alpha = 0.05.

[1] Percent galls based on number of seedlings with galls compared to total number of seedlings present.

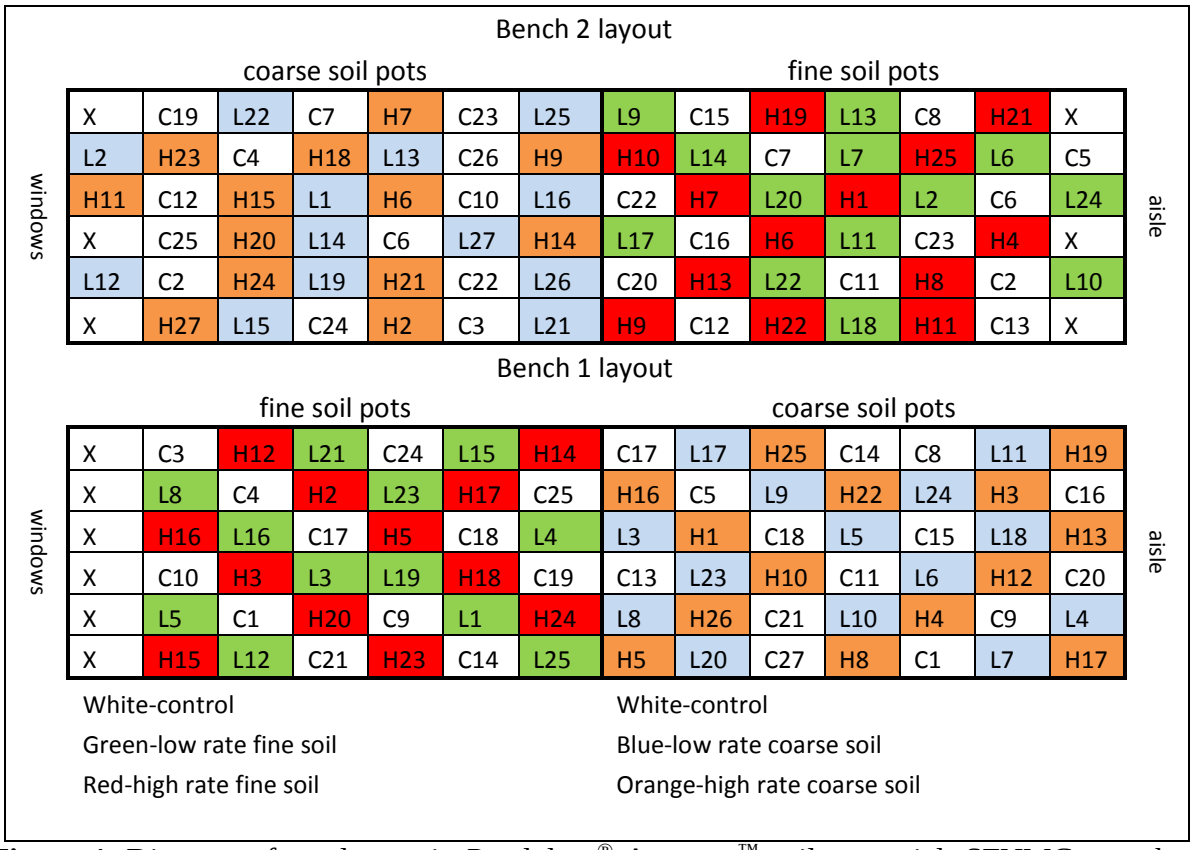

Figure 1. Diagram of pot layout in Pendulum® Aquacap™ soil type trial, SFNMC greenhouse, Auburn, AL.

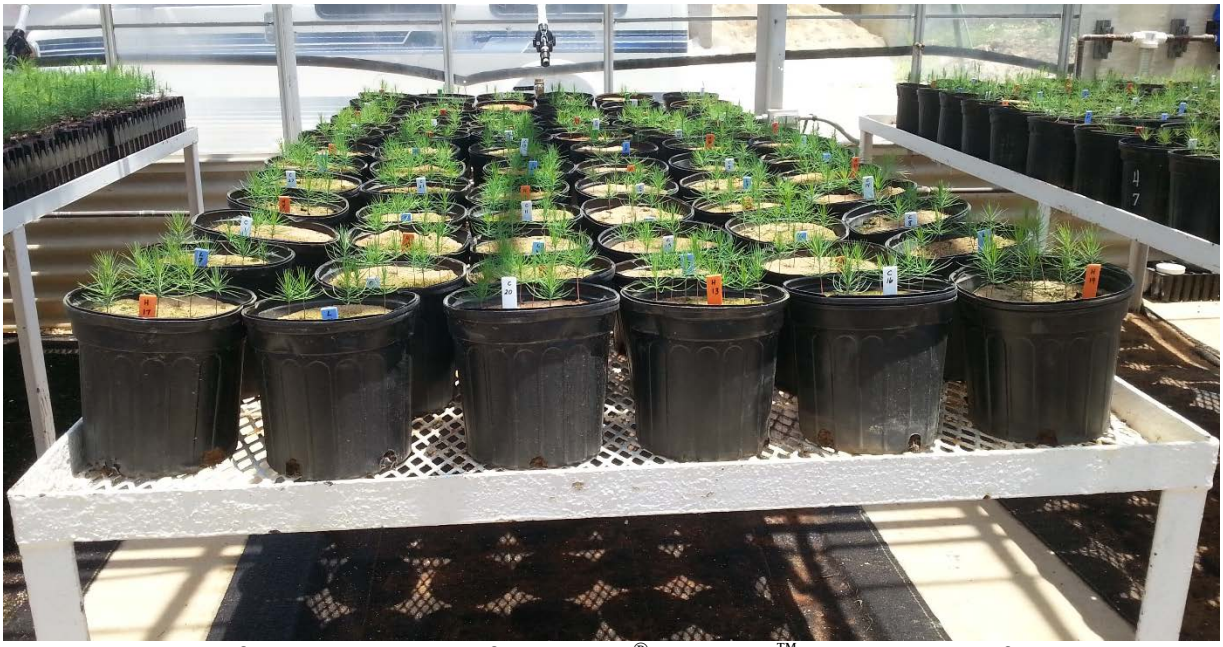

Figure 2. Bench of randomized pots of Pendulum® AquaCap™- treated pots in fine and coarse soil, SFNMC greenhouse, Auburn, AL.