Auburn University
Southern Forest Nursery
Management Cooperative

RESEARCH REPORT 14-01

OPERATIONAL APPLICATION OF PENDULUM® AQUACAP™ (PAC) TANK MIXED WITH GOAL® AT THE TIME OF SOWING REDUCES PROSTRATE SPURGE WITHOUT THE FORMATION OF HERBICIDE GALLS.

by
Scott Enebak, Nina Payne, Barry Brooks and Doug Shelburne

INTRODUCTION

The formation of herbicide galls from the postemergent use of Pendulum® AquaCap™ (PAC) (38.7% pendimethalin) on loblolly pine (Pinus taeda) seedlings has been documented in previous small-scale Nursery Cooperative herbicide trials (South and Hill 2009, Jackson and Brooks 2012); however, no operational trial has been conducted to evaluate its effect on bareroot seedlings following its application at the time of sowing. As a pre-emergent herbicide, PAC has been recommended for weed control such as prostrate spurge (Chamaesyce maculate) (South and Hill 2008), as has Goal®2XL (22.3% oxyfluorfen). Since the best time to avoid gall formation with the use of PAC is at the time of sowing, it makes good economic sense, saving fuel and time, to attempt tank mixing PAC with Goal® and apply both at the time of sowing. The objective of this study was to evaluate loblolly pine seedling tolerance to gall formation and prostrate spurge control following operational pre-emergent applications of Pendulum® AquaCap and Goal® applied simultaneously with a soil stabilizer in second year fumigated ground.

METHODOLOGY

The large-scale operational trial was conducted at Weyerhaeuser's Pine Hill Nursery in Camden, Alabama. To determine the effects on loblolly pine seedlings and the measure of control of spurge, a tank mix of Pendulum® AquaCap™, Goal®2XL and soil stabilizer was applied at two rates and compared to operational control plots using Goal® 2XL only with soil stabilizer (Table 1.) All applications were made pre-emergent on second year fumigated ground at the time of sowing. The herbicides were applied by Weyerhaeuser Nursery staff using their operational procedures.

Each treatment plot was 3 seedling beds wide and 520 feet in length and was replicated four times. Weed populations were determined by counting weeds in 10 plots (9" x 4') in each treatment between May and October. To determine seedling density, seedling counts were taken from within a 9" x 4' counting frame in June, July and November 2013. The counting frame was placed on four plots each on beds 2, 5 and 8 within the nursery unit of each treatment replication. At the end of the growing season (November 2013), all seedlings from rows 2, 4 and 6 within the counting frame were removed from sample beds 2, 5 and 8 and brought to the Nursery Cooperative laboratory for

measurement and evaluation. To determine the effects of the herbicide tank mix, root and shoot dry weights, shoot heights and root collar diameters were measured as well as gall presence evaluated. Each seedling was recorded as plantable (non-cull) or cull based on RCD.

RESULTS AND DISCUSSION

The addition of PAC in the tank mix of Goal® at the time of sowing reduced the amount of prostrate spurge with both the Goal® + 34 and 68 oz/a of PAC treatments having significantly less prostrate spurge than the Goal® only plots (Figure 1). While the Goal® + PAC 68 had fewer prostrate spurge plants, there was no statistical difference in the quantity of spurge between the low and high rates of the PAC and Goal® combinations. This indicates that the lower rate combination of PAC and Goal®, mixed with a soil stabilizer, and sprayed as a pre-emergent, could be sufficient for effective spurge control.

Seedling density counts were made in June, July and November on the three treatments with the data shown in both Table 2 and Figure 2. Seedling densities ranged from 25 to 30 seedlings per ft^2 among the three herbicide combination treatments. When comparing the three treatments, there were slightly lower seedling counts and statistical differences when comparing the Goal® only and the high rate of Goal+PAC (68 oz/a) to the low rate of Goal+PAC (34 oz/a). This difference was observed in all three data collection periods. In all of our trials with PAC we have never observed a reduction in seeding densities AND with the lower of the two rates used. We speculate that this effect (lower seedling numbers) is an artifact of sowing densities and what we would call a Type III error, reporting a treatment effect (reduced densities) when there was no treatment effect. This was the only seedling characteristic measured which showed any negative effect using the low rate (34 oz/a) of the Goal + PAC combination.

Dry root weight and dry shoot weight measurements were made and root-weight ratios were calculated on seedlings from all three treatments. No differences were seen when comparing the Goal® only and the two rates of tank-mixed PAC (Table 3, Figure 3). The number of culls, plantable seedlings and seedlings with herbicide galls (zero) were counted from each treatment, and like the biomass, there were no differences observed when comparing the Goal +PAC treatments with the Goal® only application. Most importantly, there were no galls identified on any seedling measured (Table 3). Seedling heights were also measured and no differences in seedling size were measured (Table 3). Root collar diameters were measured and a difference was seen when comparing the Goal® treatment to the high rate combination of Goal +PAC and Goal® with smaller root collar diameters being measured on the high rate combination (Figure 3).

MANAGEMENT IMPLICATIONS

1. The use of both low and high rates of pre-emergent applications of Pendulum® AquaCap™ and Goal®2XL, applied with a soil stabilizer, had no adverse effects on loblolly pine seedling densities AND did not result in herbicide gall formation.

2. The use of both low and high rates of pre-emergent applications of Pendulum® AquaCap™ and Goal®2XL, applied with a soil stabilizer, greatly reduced the prostrate spurge population in the second year since soil fumigation. Since there was no significant difference in the low vs. the

high rate of PAC use with respect to prostrate spurge control, it is possible that the lower rate of chemical could be used as part of an effort to reduce herbicide costs.

LITERATURE CITED

Jackson, P. and Brooks, B. 2012. Effects of Herbicide Gall Formation and Survival from Applications of Undiluted Pendulum® AquaCap™ to Loblolly Pine Seedlings. RESEARCH REPORT 12-05, Southern Forest Nursery Management Cooperative, Auburn University. 10 pp.

South, D. B. and Hill, T. 2008. Spurge Reduces Seedling Growth. RESEARCH REPORT 08-05, Southern Forest Nursery Management Cooperative, Auburn University. 4 pp.

South, D. B. and Hill, T. 2009. Herbicide Galls on Loblolly Pine Seedlings. RESEARCH REPORT 09-01, Southern Forest Nursery Management Cooperative, Auburn University. 7 pp.

Table 1. Herbicide treatments applied with soil stabilizer to loblolly pine at the time of sowing, Pine Hill Nursery 2013

Treatment	**Pre-emergent Herbicide** *(Trade Name)*	**Product** *(oz/ac)*
Goal	Goal® 2XL	32
Goal+PAC 34	Goal® 2XL+Pendulum® AquaCap™	32+34
Goal+PAC 68	Goal® 2XL+Pendulum® AquaCap™	32+68

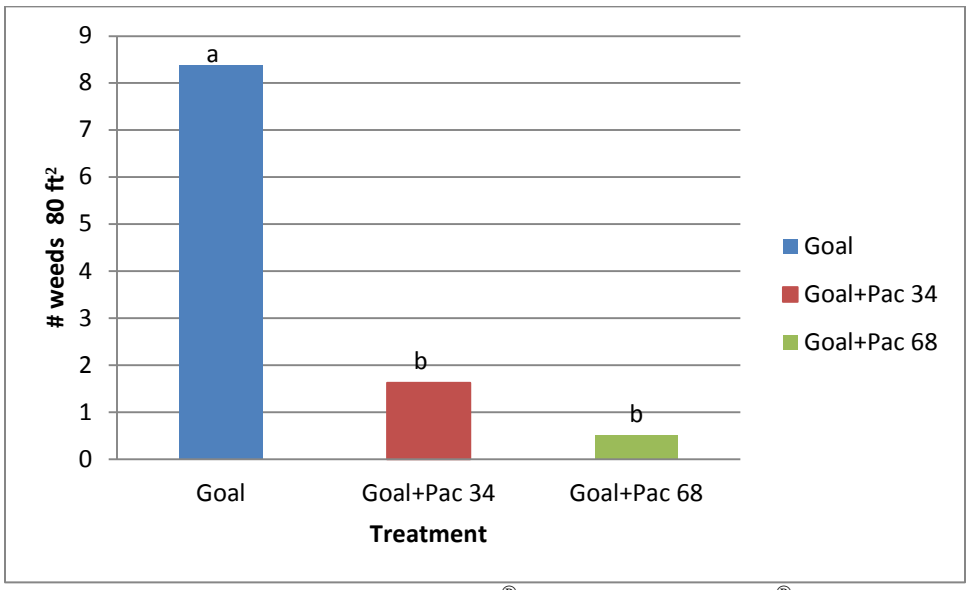

Figure 1. Effect of tank mixes of Goal® 2XL and Pendulum® AquaCap™ on prostrate spurge control, Pine Hill Nursery 2013.

Goal®2XL at 34 oz/ac, Goal®2XL at 34 oz/ac + PAC at 34 oz/ac, Goal®2XL at 34 oz/ac + PAC at 68 oz/ac. If letters are present, they denote significant differences from the control within the characteristic measured using Duncan's Multiple Range test @ alpha=0.05 level.

Table 2. Effect of tank mixes of Goal® 2XL and Pendulum®AquaCap™ on seedling densities over the growing season, Pine Hill Nursery 2013.

	Seedling Densities		
Trt	**June (ft²)**	**July (ft²)**	**Nov (ft²)**
Goal only	27.6 a	29.6 a	29.1 a
Goal+PAC34	25.0 b	25.8 b	25.9 b
Goal+PAC68	28.9 a	30.7 a	30.2 a

Goal®2XL at 34 oz/ac, Goal®2XL at 34 oz/ac + PAC at 34 oz/ac, Goal®2XL at 34 oz/ac + PAC at 68 oz/ac. If letters are present, they denote significant differences from the control within the characteristic measured using Duncan's Multiple Range test @ alpha=0.05 level.

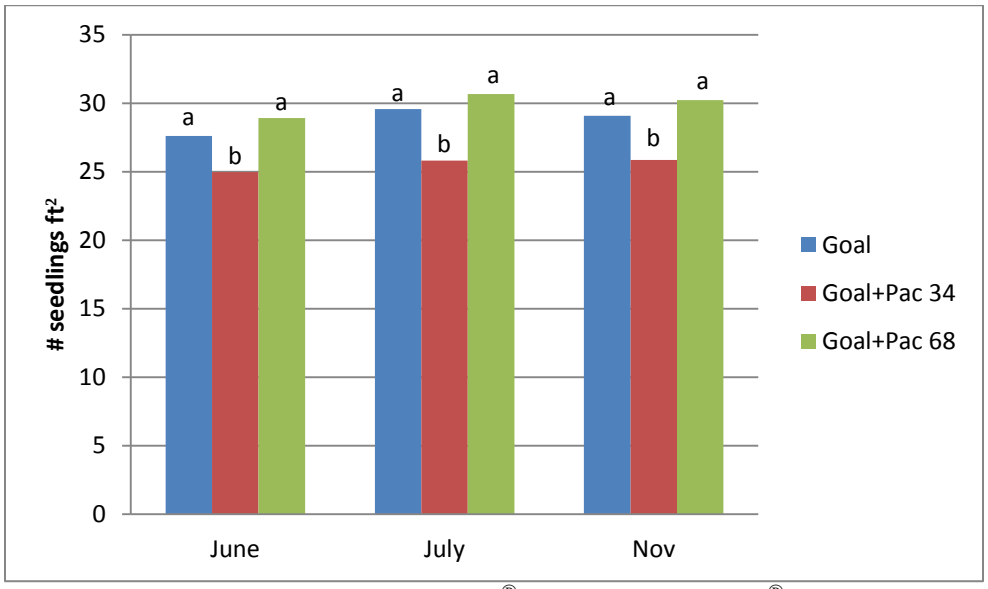

Figure 2. Effect of tank mixes of Goal®2XL and Pendulum®AquaCap™ on seedling densities, Pine Hill Nursery 2013

Goal®2XL at 34 oz/ac, Goal®2XL at 34 oz/ac + PAC at 34 oz/ac, Goal®2XL at 34 oz/ac + PAC at 68 oz/ac. If letters are present, they denote significant differences from the control within the characteristic measured using Duncan's Multiple Range test @ alpha=0.05 level.

Table 3. Effect of tank mixes of Goal®2XL and Pendulum®AquaCap™ on seedling root weight, shoot weight, shoot height, root weight ratio and gall formation, Pine Hill Nursery 2013.

Treatment	RtWgt (g)	ShtWgt (g)	ShtHgt (cm)	RWR (%)	Galls (ft^2)
Goal	0.427 ab	2.16 ab	27.2	0.167	0.0
Goal+PAC34	0.486 a	2.36 a	27.4	0.171	0.0
Goal+PAC68	0.417 b	1.98 b	25.8	0.174	0.0

Goal®2XL at 34 oz/ac, Goal®2XL at 34 oz/ac + PAC at 34 oz/ac, Goal®2XL at 34 oz/ac + PAC at 68 oz/ac. If letters are present, they denote significant differences from the control within the characteristic measured using Duncan's Multiple Range test @ alpha=0.05 level.

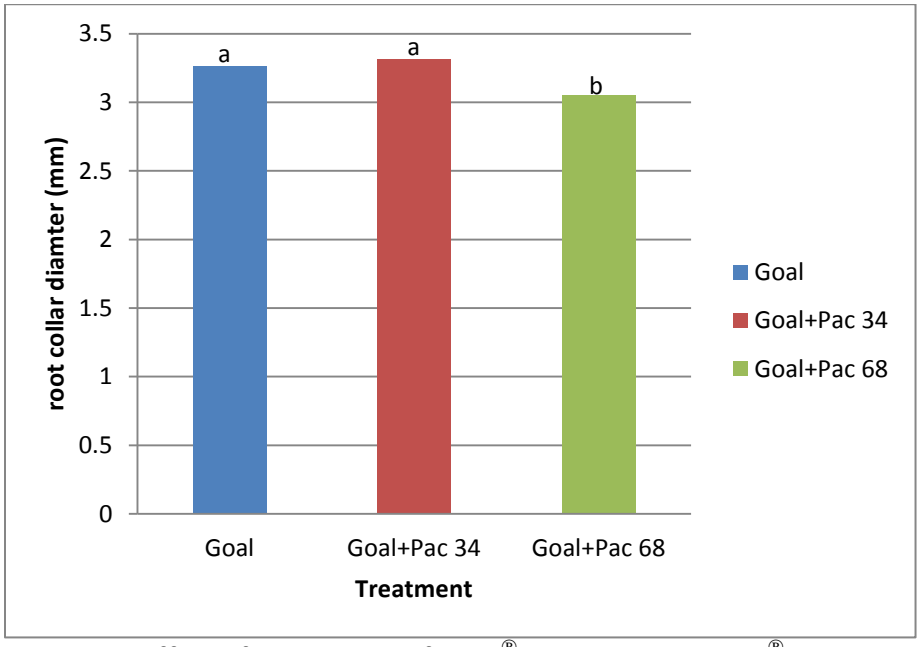

Figure 3. Effect of tank mixes of Goal®2XL and Pendulum®AquaCap™ on root collar diameter (RCD), Pine Hill Nursery 2013.

Goal®2XL at 34 oz/ac, Goal®2XL at 34 oz/ac + PAC at 34 oz/ac, Goal®2XL at 34 oz/ac + PAC at 68 oz/ac. If letters are present, they denote significant differences from the control within the characteristic measured using Duncan's Multiple Range test @ alpha=0.05 level.