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TECHNICAL NOTE

IRON CHELATE DAMAGES CONTAINERIZED JACK PINE CROPS

Injuries to a crop of jack pine seedlings were noted in a New Brunswick tree nursery in June, 1986. The injuries were characterized by foliage wilting, yellow desiccated roots, and limited lateral root development. During the growing season the tips of older needles gradually turned red-brown.

The problem was thought to have originated either from beginning fertilizer application too soon after seedling emergence or because of poor water quality. A problem with water quality was documented in earlier experiments but was eliminated by changing the source of irrigation water.

A series of trials was conducted at the Acadia Forest Experiment Station greenhouses with early fertilization, high nitrogen fertilization, and different levels of iron chelate applications. As these experiments were designed to simulate nursery practices, commercial soluble fertilizers were used. The results of these trials are presented here.

1. Early fertilization did not injure jack pine seedlings;
2. High phosphorus starter formulations tended to yield best early growth of jack pine seedlings;
3. High nitrogen concentrations reduced early jack pine seedling growth; and
4. High levels of iron, from the application of iron chelate to correct iron-chlorosis, injured jack pine seedlings.

EARLY FERTILIZATION

A fertilizer trial was conducted in July 1986 to determine if early fertilization was the cause of injuries to the seedlings. From this experiment it was evident that there was no injury from early fertilization. However, it was evident that the Plant-Prod 11-41-8 forestry seedling starter at both 50 and 100 ppm-N, produced better 6-week-old jack pine seedlings with respect to mean height and total seedling dry weight, than did the Plant-Prod 20-20-20 all purpose fertilizer at the same concentrations.

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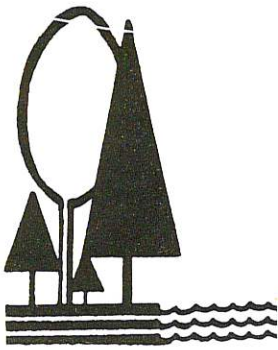

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HIGH NITROGEN FERTILIZATION

Based upon the results of the above test, a second trial was initiated in August. Nitrogen concentrations were increased in order to observe potential damage to the shoots and roots with early fertilization. Four concentrations of the forestry seedling starter (11-41-8 at 50, 100, 200, and 400 ppm-N) were applied. For these nine-week-old jack pine seedlings the best growth occurred when the nitrogen concentration was between 100 and 200 ppm (Table 1). The highest nitrogen concentration resulted in loss of seedling growth.

Table 1. Effects of Plant-Prod 11-41-8 forestry seedling starter at four concentrations on the morphological characteristics of 9-week-old jack pine seedlings grown in peat-filled FH 408 Paperpots

Treatment	Nitrogen concentration (ppm)	Mean height (cm)	Mean root-collar diameter (mm)	Total dry weight (mg)	Shoot/root ratio
Water only	0	5.8	0.7	55	2.6
11-41-8	50	10.5	0.9	134	4.3
11-41-8	100	10.8	1.0	146	5.4
11-41-8	200	9.9	0.9	140	4.5
11-41-8	400	7.8	0.8	98	5.0

Problem - Iron Toxicity

A possible explanation for the injury to the jack pine crop in the nursery was discovered in the second experiment described earlier. One-half of each tray was separated by a plastic strip and treated with an application of trace elements, plus iron chelate and magnesium sulphate. Control trays received only water when necessary. One hundred times the usual amount of trace elements, plus iron chelate and magnesium sulphate was applied to one-half of each of the fertilized trays. Within three days, symptoms of foliage and root injury were noted which were similar to those at the nursery where the problem was first noticed. Although several elements and their interactions could have caused the symptoms, we decided to test for iron toxicity as this was the only microelement applied at the nursery where the problem occurred in June 1986.

IRON CHELATE FERTILIZATION

A third experiment was established in November, using eight fertilizer/iron treatments each with three replications (Table 2). One of the treatments was a forestry seedling starter formulation which contains twice the iron chelate found in the suppliers regular starter. The other seven treatments included 20-20-20 applied at 100 ppm-N, with applications of supplemental chelated iron which increased in multiples of 50 ppm from 0 to 300.

Within two weeks, all treatments that had received supplemental iron chelate showed damage increasing with increases in iron concentration. This damage was similar to that in the second experiment where iron chelate had been accidentally applied at an excessive concentration. Foliage

and root injury increased significantly with increases in iron concentration, while total seedling dry weight decreased at the 95% confidence level (Table 2).

Table 2. Effects of fertilizers (100 ppm-N) and supplemental iron chelate on the morphological characteristics of 12-week-old jack pine seedlings grown in peat-filled multipot 2 containers*

Treatment	Added iron concentration (ppm)	Mean height (cm)	Mean root-collar diameter (mm)	Shoot weight (mg)	Root weight (mg)	Total dry weight (mg)	Shoot/root ratio
		b	a	a	a	a	c
11-41-8	0	11.6	1.5	1334	201	1535	6.8
		a	b	a	a	a	c
20-20-20	0	12.1	1.5	1350	223	1573	6.2
		c	c	b	b		c
20-20-20	50	10.8	1.2	1095	155	1250	7.3
							c
20-20-20	100	8.5	1.2	948	154	1102	6.2
		e	d				c
20-20-20	150	7.1	1.1	879	133	1012	6.7
		f	e	d	c	d	c
20-20-20	200	6.1	0.9	568	85	653	6.9
		g	f	de	d	de	b
20-20-20	250	5.4	0.8	494	61	555	8.5
		g	g	de	d	de	a
20-20-20	300	5.3	0.8	460	48	508	9.8

*Morphological characteristics sharing the same letter between treatments are not significantly different at the 95 percent confidence interval.

CONCLUSIONS

Although literature on iron toxicity is generally nonexistent, and iron toxicity previously has not been reported in forest tree nurseries, this appears to be the problem encountered at a New Brunswick nursery in June 1986. Nurserymen should be alerted to this problem.

Iron deficiencies are commonly encountered in forest nurseries that produce a variety of pine and spruce species. Consequently, growers routinely apply iron chelates with their fertilizers. Our research has shown that application of iron chelates at concentrations as low as 50 ppm iron can damage seedling roots and reduce crop growth.

This problem occurred because of the technique used for applying fertilizer in some containerized forest tree nurseries. Historically, a specific amount, by weight, of fertilizer in concentrated solution was applied in each greenhouse in one application per week. If supplemental iron was needed, it also was amended by weight, according to recommendations from the supplier.

When growers switched from paperpots to solid-wall containers, many also changed from periodic to replacement or constant fertilization. With

this technique, the concentration of each nutrient in the applied fertilizer solution is calculated in parts per million and more appropriate concentrations of iron chelate are used, usually 4-7 ppm iron.

We suspect that some injuries which were seen in past years in container crops of spruce and pine could have been caused by application of toxic quantities of iron chelate.

Early fertilization did not injure the jack pine seedlings, although climate and greenhouse management can cause environmental damping-off or root and shoot injuries by accumulation of excessive salts.

High nitrogen fertilization resulted in a reduction of seedling growth. It also leads to seedlings with excessive height, poor root development, and susceptibility to injuries by frost, overwintering, or diseases such as grey mold.

P.L. Allen
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