Special precautions needed

by

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Urea fertilizer toxic to young jack pine seedlings

Two greenhouse experiments were performed at the Great Lakes *Forest Research Centre to evaluate the effects of urea fertilizer on 1-nlonthold jack pine seedlings. In the first. urea* was surface *applied ire pellet or solution form* at *fire replicated rates to a* sandy *soil ire pots* containing *I (1 seedlings per pot. Seedl. ing mortality increased as the* rate *of nitrogen increased. with all seedlings dying at the 600 kg N/ha treatment level. In the second experiment. urea pellets were placed net the soil surface beside seedling sterns and at prescribed* distances, and high *mortality resulted when even one pellet* was *placed closer* than *0.6 cm.*

Nitrogen, an essential element for plant growth, is commercially available as a fertilizer in several forms such 4, urea. ammonium nitrate, urea-formaldehvde, and ammonium sulphate. Urea ($CO(NH_2)_2$) contains 45 percent N, and at present is the cheapest nitrogen product. Other things being equal, this makes it more attractive than other forms. However, urea is reported to damage or kill agricultural crop seed and seedlings unless special precautions are taken in application (2). Gasser CIO provides an excellent literature review on this subject, and recommends side-dressing urea or mixing it with acid materials. such as super-phosphate, to avoid crop loss. Mortality stay occur through exposure to *biuret-a* toxic compound formed during manufacture that may exist in urea pellets-or to ammonia. which is released during the breakdown of urea after addition to the soil.

Forest nurseries in Ontario do not usually use urea in their fertilizer programs; however, studies are continuing here and elsewhere to compare the forms of nitrogen available for use in nurseries. Injury caused by urea has not been widely reported, most likely because seedlings are quite old before its application. Radwan *et al. (4)* did not report damage when 1-year-old Douglas-fir (Pseudotsuga menziesii *(Mirb.) Franco)* seedlings were broadcast fertilized with urea at a rate of 50 kg/ha. Similarly, Sander (5) found no adverse effect on seedling density when urea was roto-tilled into the nursery bed at 240 kg/ha just prior to seeding of lodgepole pine *(Tiers contorta* var. *latifolia* Engelm.) It is interesting to note, however, that Auten (1) has reported density reduction of shortleaf pine *(P. echinata* Mill.) and pitch pine (P. *rigida* Mill.) seedlings when ammonium nitrate was applied at seeding time.

Opinion is still divided on the use of urea for fertilizing tree seedlings. Nursery and forest managers should be aware of some of the possible dangers inherent in its use, and of some of the steps they can take to avoid damage prior to fertilizing young seedlings with it.

This note reports on greenhouse trials performed at this research center to indicate the effects of urea-broadcast or placed on the soil surface-upon 1-month-old jack pine (P. banksiana Lamb.) seedlings.

Method

In the first study, 40 peat pots (10.2 cm x 15.2 cm x 7.6 cm) were filled with a podzolic Bf horizon sand. sown with 20 jack pine seeds from Ontario Seed Zone 3E (Iroquois Falls), well watered, and placed in the greenhouse. The experiment was established 30 days after sowing, the factorial design consisting of five nitrogen levels x two forms of urea, with four replications. Urea was applied in pellet or solution form at 0. 100, 200. 400, and 600 kg N/ha.

Seedlings were thinned to 10 per pot 30 days after sowing, and fertilizer treatments were administered to each pot. Urea pellets were spread l, ' hand uniformly across the wet soil surface at the prescribed rate, and watered lightly. The urea solution was obtained by grinding urea pellets using pestle and mortar, and adding distilled water. The solution was then mist-sprayed onto the soil. The study was maintained for **14** (lays after application of fertilizers. Seedlings were watered daily by mist to soak the soil thoroughly.

The second test was performed to determine how close urea pellets could be placed to a 1-month-old seedling without causing mortality. Twenty-five jack pine seeds were sown at 12.7 cm x 12.7 cm spacing in each of twelve 76.2 cm x 76.2 cm x 25.4 cm plastic tubs containing the Bf horizon sand. One month after slowing, one, two, or three urea pellets were placed on opposite sides of the seedlings, close against the stern, and at distances of .6 cm. 1.3 cm. 2.5 cm, and 5.1 cm from the stem. The soil was kept well watered, and the seedlings were assessed daily during the next 14 days.

Results

The application of urea fertilizer to 1-month old jack pine seedlings significantly reduced seedling survival even at rates as low as 100 kg N/ha (table 1). No differences in survival rate were found between pellet and solution forms of urea at 100, 400, and 600 kg N/ha, but survival was significantly reduced using solution at 200 kg N/ha. Nitrogen rates of 400 and 600 kg/ha as urea resulted in seedling mortality within 48 hours after application while mortality at the 100 and 200 kg N/ha rates occurred over a 6-day period. Soil surfaces at the 600 kg N/ha treatment level darkened noticeably 5 days after treatment application.

Seedlings were killed within 48 hours by contact with even one pellet of urea

TABLE 1.—*Effect of level and form of urea on survival of 1-month-old jack pine seedlings*

Level of nitrogen	Form of urea application	
	Pellet	Solution
kg/ha	*Percent survival*	
Control	100a	100a
100	71b	72b
200	67b	24c
400	6de	11d
600	0e	0e

Note: Common letters denote treatments not significantly different at the 5 percent level.

(table 2). One to three pellets placed at a distance of 0.6 cm from the steal also caused heavy mortality. incidence of seedling death at other treatment distances was much lower.

Discussion

Urea may significantly reduce survival among 1-month-old jack pine seedlings in a sandy soil, particularly at levels above 200 kg N/ha when applied in granular form and above 100 kg N/ha when applied as a solution. As the level of fertilizer increases, so does the probability that pellets will occur beside a seedling stem, and the results show that the risk of mortality also increases when the pellet is closer to the stem.

The findings of this study suggest

TABLE 2.—*Effect of number of urea pellets and distance of placement from seedling stem on survival of 1-month-old jack pine seedlings*

Distance of pellet from stem	Number of pellets		
	1	2	3
cm.	*Percent survival*		
0.0	0	0	0
0.6	14	10	9
1.3	84	80	82
2.5	95	94	94
5.1	99	100	98

the need to examine nitrogenous fertilizer. other than urea for broadcast surface application to nursery and forest soils supporting voting jack pine seedlings. Results are compatible with those previously reported for agricultural crops by Gasser (3). Methods of applying fertilizer urea (other than broadcasting it) which place the pellets away from seedlings will not likely result in significant damage to seedlings.

Summary

Urea, in either pellet or solution form. was found to reduce survival of 1mouth-old jack pine seedlings significantly when applied to the soil surface at the rates of 100. 200. 400. and 600 kg N/ha. Losses varied directly with increased application rate. Mortality was significantly higher at the 200 kg N/ha level when urea was applied as a solution than as a pellet. Placement of pellets more than 0.6 cm away from the seedlings is necessary if seedling losses are to be avoided.

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