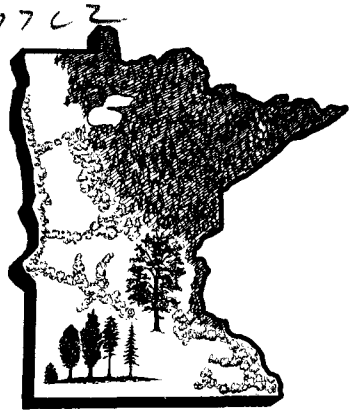

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THE EFFECT OF FERTILIZERS ON THE AVAILABLE NITROGEN CONTENT OF A NURSERY SOIL AND ON THE NITROGEN CONCENTRATION IN RED PINE SEEDLINGS

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Changes in the "available" nitrogen content of the soil, and in the nitrogen content of red pine seedlings were measured during the summer of 1957 at the General Andrews Nursery, Willow River, Minnesota.

The soil in the nursery is Omega sand, an excessively drained soil which developed from deep, non-calcareous well-sorted glacial outwash sands. The sand content of the soil in the plots studied ranged from 91 to 97 percent. The reaction of the soil at three of the locations was pH 5.5 to 5.7, within the range considered to be optimum for red pine. The reaction of the fourth bed was pH 4.7, however. Cation exchange capacities ranged from 5.0 to 6.3 M.E. per 100 grams of soil, the total nitrogen content of the soils was 0.068 to 0.132 percent, and the organic matter content ranged from 2.6 to 7.6 percent, depending on the amount of peat added.

All plots except the check plot received 100 pounds of P_2O_5 and 100 pounds of K_2O per acre. Rates of ammonium nitrate application were 0, 50, 100, and 150 pounds of nitrogen per acre. Ammonified peat and urea formaldehyde were each applied at the rate of 100 pounds of nitrogen per acre. Each fertilizer application was studied in four locations, two on 2-0 seedlings and two on 3-0 seedlings. The fertilizer was all applied in the solid form on May 28, 1957.

A comparison was made of the effect of various rates of application of ammonium nitrate on the "available" (ammonium and nitrate) nitrogen content of the soil. Figure 1 shows that about two months after the application of ammonium nitrate fertilizer the available nitrogen content of the soil was about the same in all of the plots regardless of the amount of nitrogen applied. This rapid loss of nitrogen is in all probability due to either leaching by water from rainfall and from the irrigation system or loss in gaseous form to the air. This coarse textured soil lends itself to rapid leaching and high air exchange. The applied nitrate nitrogen had almost completely disappeared by the time of the first sampling. In other words, the available nitrogen was mostly in the ammonium form throughout the growing season. Because of the rapid loss of nitrogen if applied in one large application in the spring, several well-spaced uniform applications during the growing season should prove to be most productive.

Another comparison is made showing the effect of different nitrogen carriers on the content of available nitrogen in the soil (Fig. 2). Ammonium nitrate and ammonified peat supplied available nitrogen to the soil at approximately the same rate, but urea formaldehyde released less nitrogen during the early part of the growing season.

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Since any nitrogen absorbed by a plant is necessarily available, the nitrogen concentration of tree seedlings is often used as a measure of available nitrogen. From Figure 3 it can be seen that an application of 150 pounds of nitrogen per acre resulted in a greater nitrogen concentration in the seedlings than did no application of nitrogen, but that these differences became less during the last half of the growing season. A decreasing nitrogen supply was, however, not nearly as evident from measuring nitrogen concentration of the seedlings as it was from measuring ammonium and nitrate nitrogen in the soil.

There was little difference in the nitrogen supplying powers of ammonium nitrate, ammonified peat, and urea formaldehyde (Fig. 4). The first two named supplied nitrogen to the plant somewhat more efficiently than the latter. The decreasing nitrogen concentration of the seedlings from early in the growing season to the middle of August and the leveling off of the nitrogen curve in September should also be noted. This phenomenon has been observed in the leaves of larger trees and it has been explained as a dilution effect.1/ The concentration of nitrogen in the conducting vessels of a plant is greatest in early spring. As the growing season progresses, the rate of carbohydrate manufacture exceeds the rate of nitrogen flow into the leaves of the plant, resulting in a dilution of the nitrogen in the plant. In late summer the rate of growth decreases and the percentage of nitrogen remains constant.

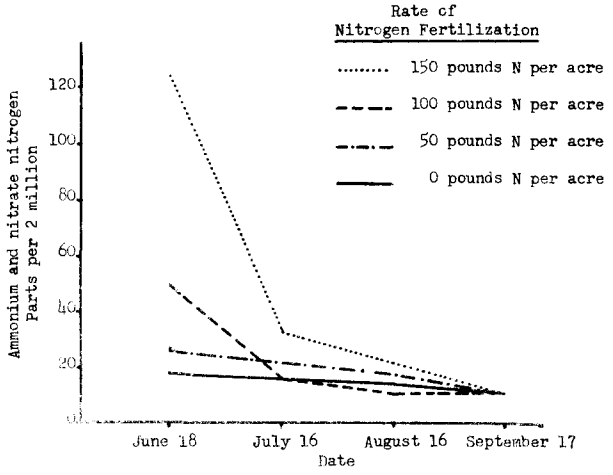

Figure 1. Available (ammonium and nitrate) nitrogen content of the soil during the growing season (1957) as affected by rate of application of ammonium nitrate fertilizer.

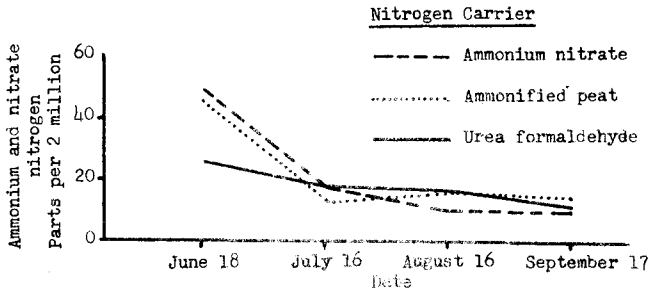

Figure 2. Available (ammonium and nitrate) nitrogen content of the soil during the growing season (1957) as affected by different nitrogen carriers applied at the rate of 100 pounds of nitrogen per acre.

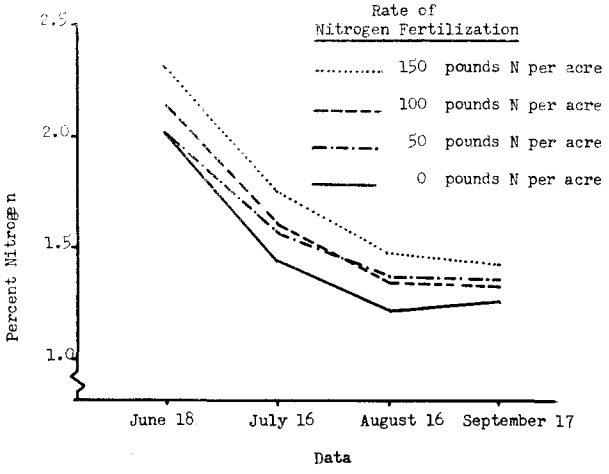

Figure 3. Nitrogen content of red pine seedling tops during the growing season (1957) as affected by rate of application of ammonium nitrate fertilizer.

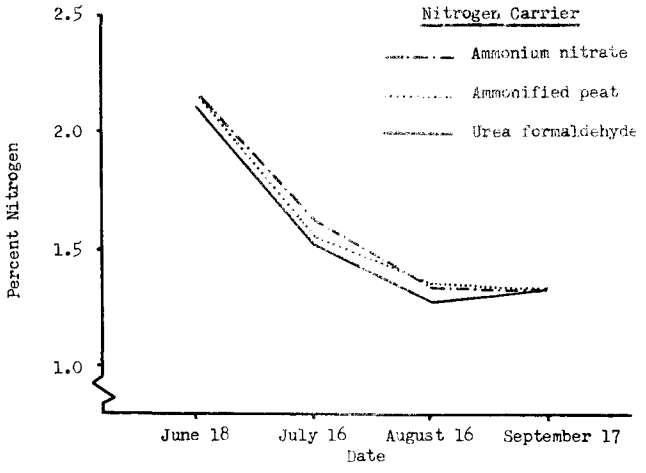

Figure 4. Nitrogen content of red pine seedling tops during the growing season as affected by different nitrogen carriers applied at the rate of 100 pounds of nitrogen per acre.

1/ Mitchell, H. L. 1936 Trend in nitrogen, phosphorus, potassium and calcium content of the leaves of some forest trees during the growing season. Black Rock Forest Pap. 1:30-44.

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