GROWTH OF SPRUCE

by
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Growth in the month after germination is quite slow. The top has developed primary needles, but the secondary needles have not yet appeared. At the end of this time the root has developed as a single, unbranched, or only slightly branched, taproot with a fairly small absorbing surface and occupying a small volume of soil. Root volume to soil volume ratio: of only 3.0×10^{-5}, compared to 7.6×10^{-5} for Jack. (Which might be comparable to Ponderosa pine?) Yet the trees' rates of uptake for N, P and K are high and increasing until about 40 days, which means that these elements must be readily available in the soil, and in sufficient concentration in the right position for the trees to satisfy their needs. After 50 days Swastika) the RATES of uptake mg./g./day drop fairly sharply; but since the plant size is increasing, the demands on the soil will be increasing. (Figure 1) RATES of uptake of N and K decline gradually from the spring peak, but that of P shows a jump around 95 days, this despite the much larger plant size; so once again P must be readily available in a suitable position if the trees are to realize their full potential.

Growth in dry weight continues as long as the soil remains unfrozen about the roots, which is well after height growth has ceased. White spruce seems able to grow well in air temperatures close to freezing. Calculating day-degrees from 42° was found to be unsatisfactory; now 34° - 36° are used. (Figure 2)

Growth of Spruce

Next spring, the RATES of growth are high once again for 30-40 days, nearly as high as the first year which, considering the larger plant size, represents quite a demand on the soil. If nutrients are not available in sufficient quantities, the trees will fall somewhere between the lines shown in Figure 3 (Sdlg. dry wt.). This represents quite a waste of potential, if large, healthy, well-balanced trees are desired. One interesting fact is that a jump in the rate of uptake of P occurs again, after about 100 days of growing time when height growth resumes, suggesting that this point in development could be governed by accumulated day degrees, and therefore be predictable. Unfertilized trees do not show this increase in rate of uptake.

If I seem to be stressing P strongly, it is only because white spruce seems to be quite sensitive to deficiencies of phosphorus, and therefore care should be taken to insure against a deficiency in the soil in that region from which the tree can absorb it. Setting a minimum value of available P is difficult, because several methods of estimating it exist, and then can give different values for the same soil. For instance, available phosphorus values for the soil I used in the greenhouse banding trial were 2.0, 2.4, 4.9, and 18.5 mg. P/100 gn. oven-dry soil. The exacting solutions remove P from different sources in the soil; so the only way to determine which of several methods is best is to compare its estimate to tree growth. Where the available P definitely is low and it is desired to increase it, banding the P fertilizer at a depth of 2-4 inches is likely the most economical way of doing so, in terms of the amount of fertilizer required. Banding entails placing the fertilizer in a restricted zone in the soil before sowing either with special machinery or by a modification in the method of bed-making.

This was tried on a small basis in Ontario two years ago, but with little success. Much of the difficulty arose in trying to band the P by the latter method. We tried broadcast-fertilizing before forming the beds by machine, which is done by scraping the earth from the paths and spreading it uniformly over the bed by the bed former. Because the paths of the nursery at which the trial was conducted are shallow, there was insufficient soil to cover the fertilizer properly. Still, the idea of banding where available P is low, is sound. All that remains to be done is to iron out the messy details of transplanting the principle into nursery practice.

Nitrogen is the opposite of phosphorus in that it can be leached from the soil. Therefore it might have to be applied more than once during a growing season to maintain the supply to the plants. Professor Armson laid out a trial to compare the effect of times of application of N and P on the growth and nutrient uptake of white spruce. Since the fertilizer was applied to the surface, or possibly because P was not limiting, there was no response to phosphorus. Total growth followed the N level (Figure 4), but no difference in total growth (dry weight) arose from treatments. (Table - N. B. - Armson, K.A., Soil Science Society of America Proceedings, Vol. 27, No. 5, Sept.-Oct. 1963, pp/596-97, Table 2). However, the periodic application (early May, June, July, August, September) produced significantly better balanced trees than did the "Normal" (May 24, June 22, July 5) or "Summer and Fall" (May 24, June 22, Sept. 7) fertilizer patterns. The periodic and summer-fall treatments produced trees with much higher N contents than the normal, indicating that white spruce can utilize N at this late date. For instance some spruce, fertilized only at the time of last application, grew significantly larger than the controls. (unfert.) Red pine grown in the same test could not utilize the late applications. White spruce seems to be a species that is quite free from frost damage. Even the trees that were fertilized late were not damaged; indeed, they might have been more hardy than the normally fertilized trees.

Most of the spruce stock in Ontario is shipped as transplants. Recent improvements in seed, spacing, and fertilizing began to produce trees that were so large as 2-2 that they were difficult to ship and plant. One superintendent has begun transplanting seedlings in the middle of the second growingseason as a 1-year-old tree. He planted the larger to be shipped as 12-12 stock, the rest as 1-2 with very good results. You can appreciate the advantage of saving a year on the rotation time and still produce sturdy, well balanced stock.

The publications on phosphorus placement mention that the response to banding depends inversely on the amount of available P in the soil. But the results of some agricultural trials indicate that the response might be independent of available soil P if nitrogen is combined in the band with the phosphorus. This might allow real savings in fertilizer and time to be realized. Professor Armson is conducting a greenhouse trial of this possibility now, using white spruce and jack pine. Van Goor 1/ in 1955 showed antagonism between N and P's uptake in larch. This is startling since both elements are essential to plant growth. Some of this effect was due to his use of the CONCENTRATIONS of these elements in the trees rather than the total uptakes; but even when this was adjusted, there was an indication of antagonism.

You have seen today what attention is paid at all, or most, nurseries to the content of shipping stock, particularly to counting and bundling them.

1/ Van Goor, C. P., Plant & Soil, Vol. 1, 1955.

Figure 5 - N, P & K Uptake RATES (mg/g/day) for 1-0 White Spruce

(Swastika Nursery)

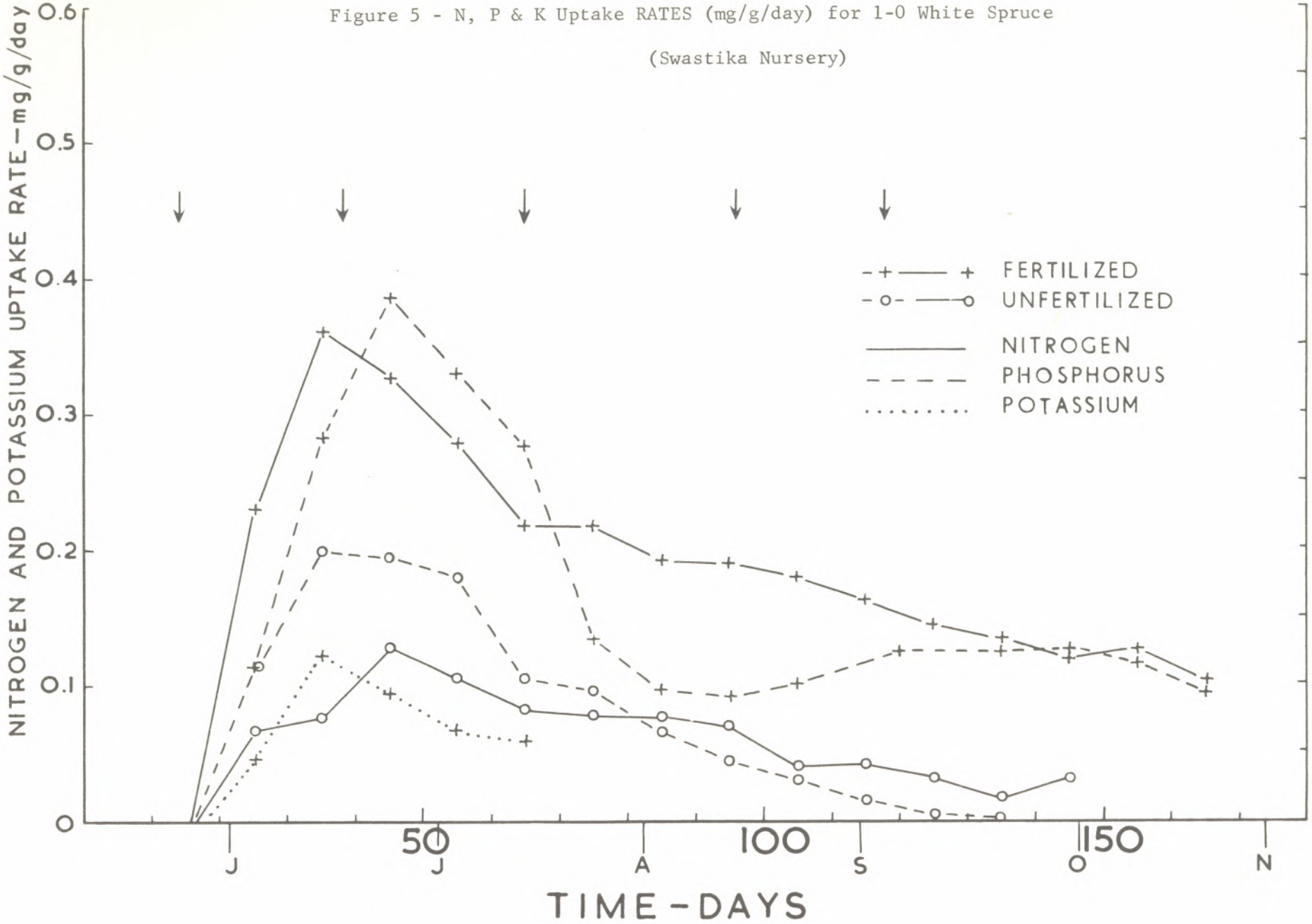

Fig. 1

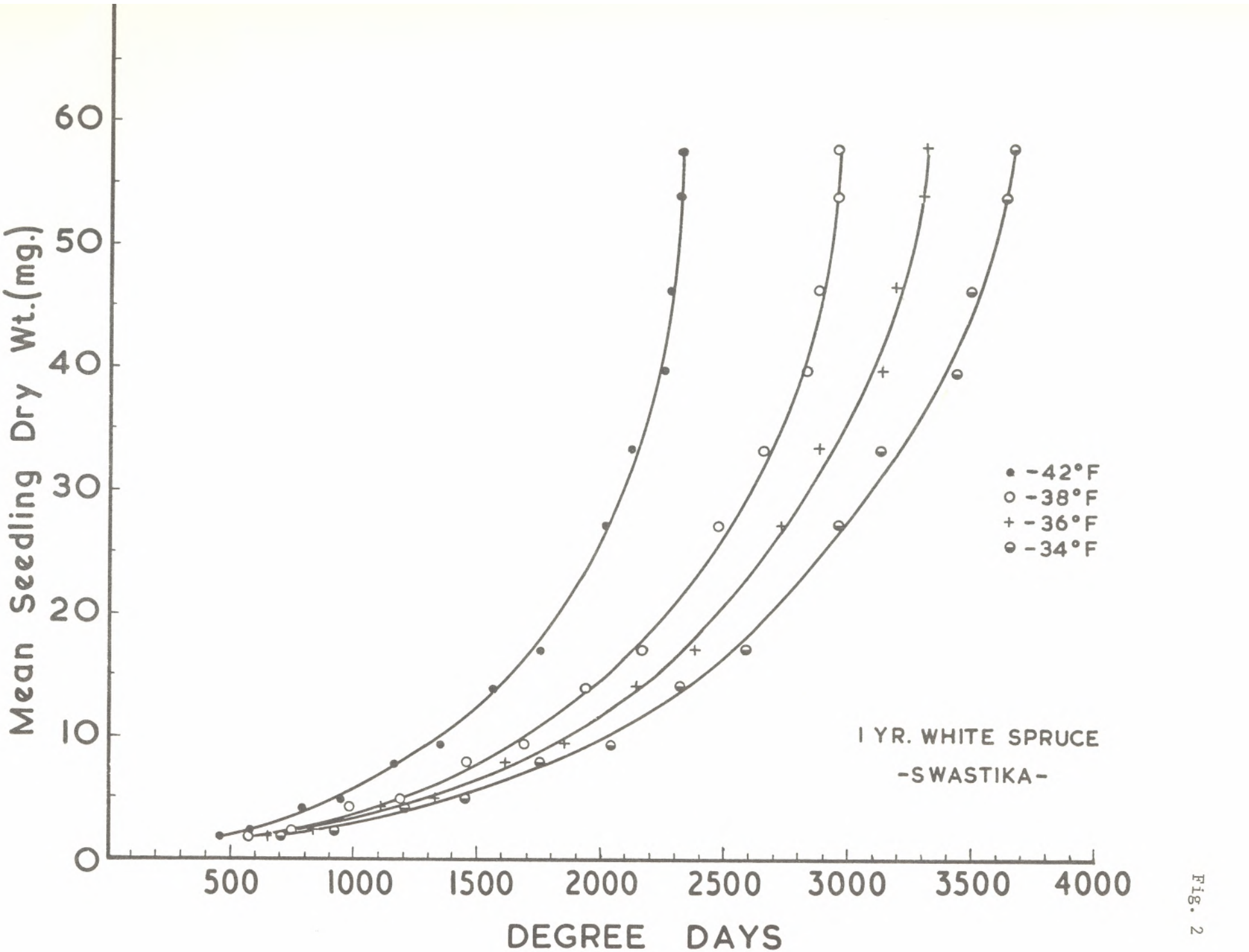
Mean Seedling Dry Wt.(mg.)
0
10
20
30
40
50
60
500
1000
1500
2000
2500
3000
3500
4000
DEGREE DAYS
• -42°F
○ -38°F
+ -36°F
⊖ -34°F
1 YR. WHITE SPRUCE
-SWASTIKA-

Fig. 2

Figure 3

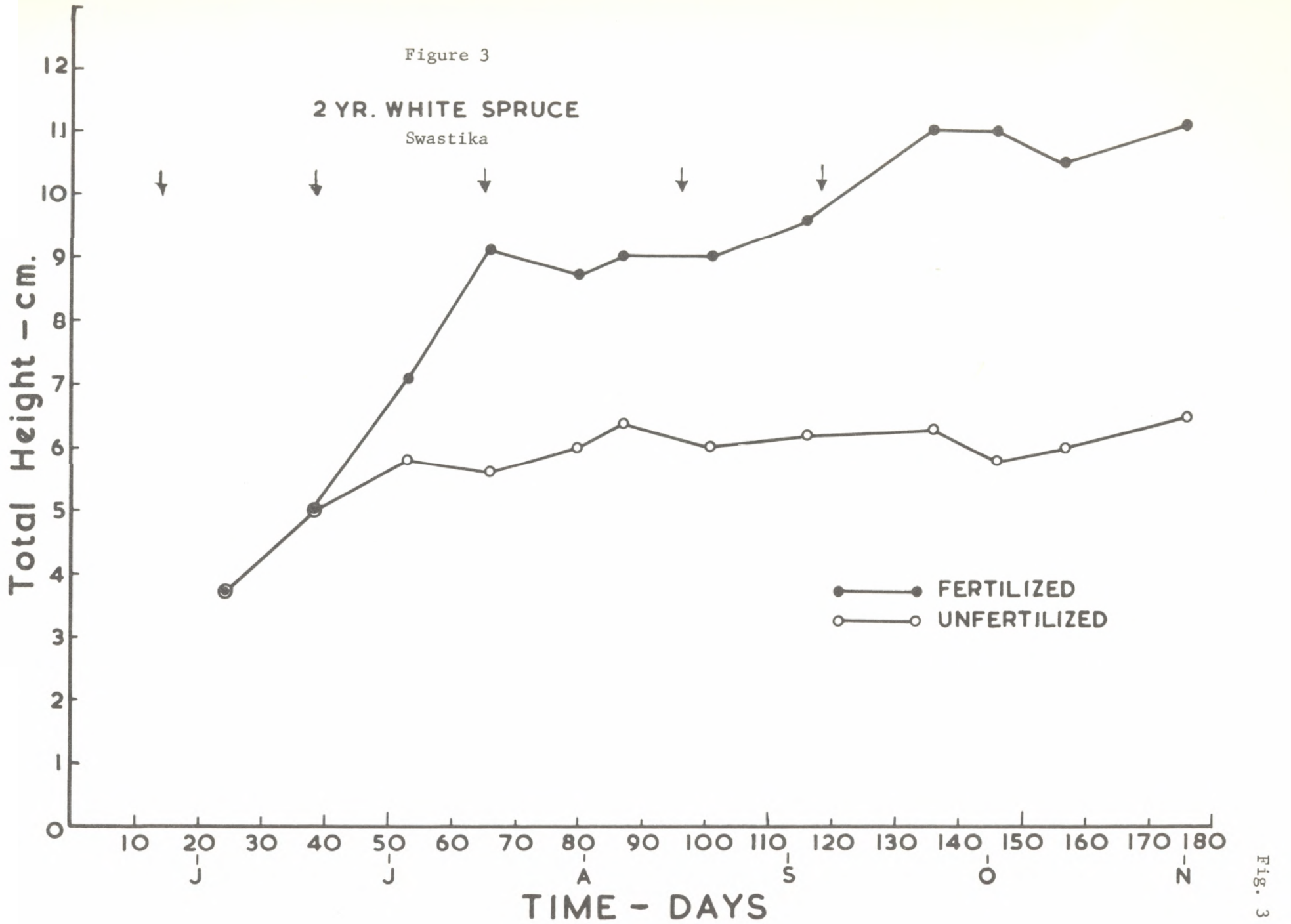

Fig. 3

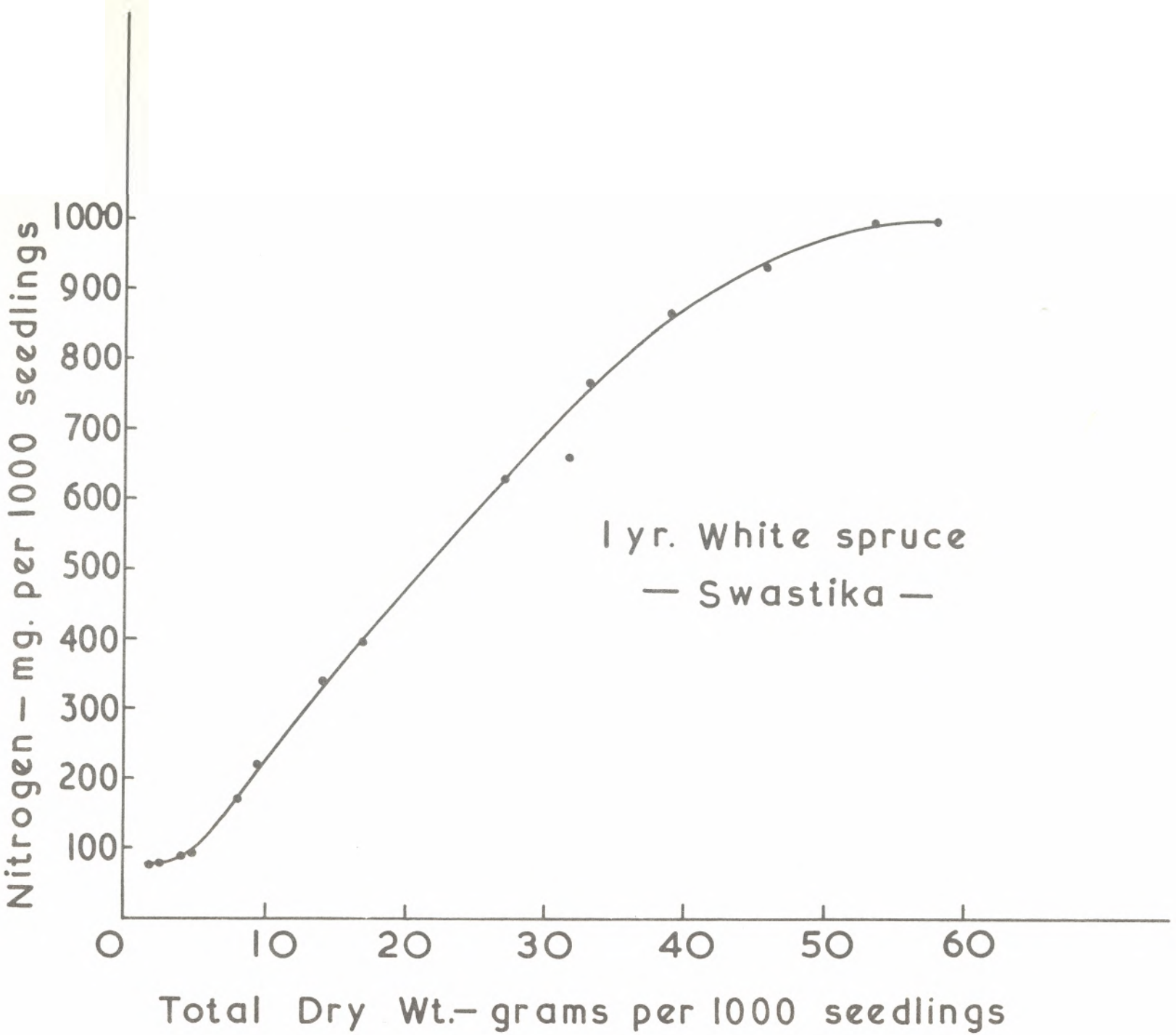
Nitrogen – mg. per 1000 seedlings
1000
900
800
700
600
500
400
300
200
100
0
10
20
30
40
50
60
Total Dry Wt.– grams per 1000 seedlings
1 yr. White spruce
— Swastika —

Fig. 4

You have also seen that advances are being made in seed quality, sowing density, disease control, fertilization, and inventory estimates. With improved storage and shipping facilities, permitting "hot" planting in many instances, can the day be far away when nurseries 17111 fill orders simply by lifting a certain length of bed, rather than by counting a certain number of trees?