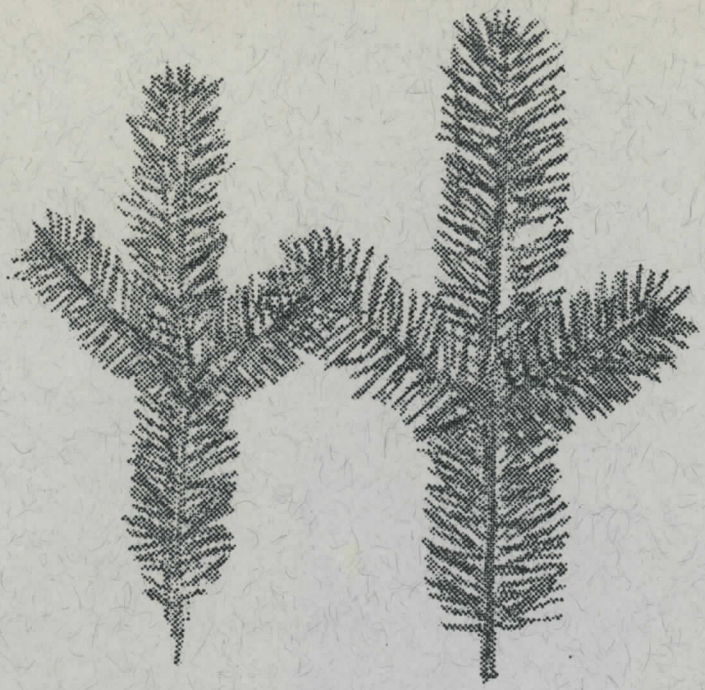
BY FERTILIZING BALSAM FIR?



Gary L. Saunders

Leroy L. Wright

Extension Division

Nova Scotia Department of Lands & Forests

Truro/June/1967

HIGHER CHRISTMAS TREE PROFITS BY FERTILIZING BALSAM FIR?

INTRODUCTION

As a cash crop, balsam fir Christmas trees rank in value with apples in this province: between two and three million dollars worth are exported each fall. Even higher returns could be realized by this industry if we could supply our quality-demanding United States market with a better grade of tree. High quality balsam fir is always in short supply.

Growing better Christmas trees requires more extensive use of proven cultivation methods such as weeding, thinning, pruning, and shaping. It also requires a continual search for new methods. One new method that looks promising is the use of commercial fertilizers in natural fir stands to promote thick, green foliage, the two features most valued by the trade. American growers are using the technique increasingly, but in Canada fertilization of forest trees has been largely aimed at boosting wood production.

On test plots* in western Nova Scotia, summer application of 50 pounds per acre each of actual nitrogen and phosphorus, and of nitrogen alone, were found to produce good results by that fall, and excellent results by the following fall. The cost per tree, including labor, was a few cents. Height growth was not noticeably accelerated by the treatments.

More local study needs to be done on this technique. Nevertheless, it appears that with proper use it could be a worthwhile investment in the cultivation of natural stands of balsam fir Christmas trees--just as mechanical treatments are proving to be. It is also possible that the chemical treatment can reduce the amount of manual cultivation needed in some stands. This paper discusses the possibilities.

---

* Established in 1964 by Extension Division, Nova Scotia Department of Lands and Forests.

OBSERVATIONS ON FERTILIZING LOCAL FIR

Over three dozen plots were set out in typical fir stands in King's and Annapolis Counties in July 1964, and various combinations of fertilizers containing nitrogen (N), phosphorus (P) and potassium (K) were applied. From the records kept, these observations were made:

1. Excellent results were obtained with a nitrogen-phosphorus (NP) mixture. Needles were longer, broader, and of a deeper green.

2. Similar results also followed the use of nitrogen alone (in ammonium nitrate, urea, and nitrate of soda forms).

3. Phosphorus and potassium produced little or no improvement, singly or combined.

4. Treated trees appeared to hold their needles better after cutting than did untreated trees; and they kept their improved colour.

5. Treated trees were not more prone to frost damage.

6. Not counting labour, the per-acre cost for the NP treatment (at 50 pounds of each element per acre) was $13, and for the N treatment (also 50 pounds per acre), $8.16.*

7. Doubling the per-acre dosage of fertilizer gave only slightly better results.

PROCEDURE

At the end of July, when height growth was complete, dry fertilizer was sprinkled by hand in a ring about the base of each tree. The stand in which the plots were located had already been thinned and weeded according to the normal practice for preparing a Christmas tree stand for production, and a stocking of about 1,000 three-foot to ten-foot trees to the acre was left. The amount of fertilizer per acre required to yield the prescribed dosage of nutrient was first figured from the percentage of the desired element in the fertilizer being used.

The material was not broadcast, as this would have caused a rapid regrowth of previously cut weed species. Large trees were given proportionately more than small trees. The fertilizer was placed under the crown area, but not within a foot or so of the stem, where feeder roots may be scarce.

* These prices could be reduced by buying in quantity.

It has been found elsewhere that one man using this method can treat about 100 trees an hour, provided thinning and weeding have made movement fairly easy. Thus on land having about 1,000 trees per acre, i.e., just over 6' x 6' average spacing, it would take about 10 man-hours to treat all trees on one acre. With a hand-operated spreader, one man can broadcast-fertilize considerably faster, provided thinning and weeding have made movement easy.

It should be noted that in actual operations there would be no need to fertilize every tree. If the grower so wished, he could treat only those trees that were due for cutting in the next season or two.

SOME QUESTIONS

Many questions about fertilizing native fir for Christmas trees have yet to be answered, such as:

1. Which fertilizer yields the best results on a given site, and which sites will not respond to fertilizing at all?

2. What amount of fertilizer gives the best results on a given area?

3. At what time of year is fertilizer best applied?

4. How long do the benefits from a single application last?

5. How much is needle retention improved?

6. Do fertilized trees resist insect and disease damage better?

7. Does fertilizing raise tree grade enough to warrant the investment of a few cents extra per tree?

8. Would continued use of fertilizers, by disrupting the normal activity of valuable soil organisms, eventually produce trees of poor color and form?

However, although there is a lack of local information on fertilizing Christmas trees, enough work has been done elsewhere on plantation stock, Christmas trees, and timber trees to suggest possible answers to these questions.

SOME POSSIBLE ANSWERS

Which Fertilizer?

Regarding the best fertilizer for a stand that needs treatment, this will doubtless vary so much in different locations that only soil and foliage tests will give an accurate answer. Though NP and N gave the best results on the plots described above, this does not mean that the same treatment would yield the same results elsewhere. Different stands of the same species can have different deficiencies.

Indeed, some stands will not even be improved by fertilizers, because they may be subject to some other condition that extra nutrients cannot relieve. For example, there can be too little or too much water, the presence of disease or harmful insects, over-exposure to wind, or recurring frost damage. Of these conditions, soil type is probably the most influential; both ill-drained clay soils and over-drained sandy soils respond poorly to fertilization.

Nonetheless, most wild stands of fir, pine and spruce on average sites appear to have nutrient deficiencies, sometimes mild, sometimes severe. Nitrogen in particular is usually low. This being so, it is likely that most such stands will benefit from the addition of nitrogen alone--especially if they are showing the symptoms that usually go with nitrogen scarcity, namely sparse, yellowing foliage. Some researchers recommend the use of a complete fertilizer (ie; NPK) where the exact nature of the deficiencies is unknown, and suggest a 1:1:1 ratio.

How Much?

How much of a certain element to add for best results will depend on how poor in usable nutrients the soil happens to be, what elements are low or missing, how large the trees are, and many other factors. These factors will vary from stand to stand. Strictly speaking, the fertilizer prescription should be matched to these conditions, especially when two or more elements are being added. In practice, however, such detailed prescribing is not often feasible. This is another reason why nitrogen, which is a fairly "safe" element where guesswork is entailed, is to be preferred. Even then, the Christmas tree grower would be wise to test his fertilizer on a small area first, using different dosages.

A safe initial dosage might be 50 pounds of actual nitrogen per acre for stands with average stocking and heights from three to ten feet. Thus a stand with about 800 stems per acre would receive about one ounce of actual nitrogen per tree, on the average. Depending on which of the standard forms of nitrogen fertilizer was being used, this would mean applying from two to six ounces

of whole fertilizer per tree, on the average. Larger trees would require more, smaller trees less, than this amount.

This brings up the matter of fertilizer composition. Most fertilizers are not pure, but contain only a percentage of their gross weight in nitrogen, phosphorus or potassium. These percentages vary with the source and chemical of the element(s) it contains. Thus among the standard dry nitrogenous fertilizers, the urea form contains 42% to 46% pure nitrogen, the ammonium nitrate form 33.5%, the ammonium sulfate form 21%, and the sodium nitrate form only 16%.

Each of these forms has certain advantages and disadvantages which must be considered before a choice is made. Thus, although the urea form yields the most nitrogen per pound of whole fertilizer, it breaks down very readily in contact with moisture, and requires dry weather for proper spreading. Ammonium nitrate fertilizer, on the other hand, is only one-third nitrogen and 20% more expensive; but because it provides half its nitrogen in a rapidly available form, and half in a more slowly available form, its effects last longer. The ammonium sulfate form sells for half the price of urea fertilizer, but contains 24% sulphur, so that in reality the nitrogen content costs nearly half again as much as it does in the urea form. Similarly, the nitrogen in sodium nitrate fertilizer costs about two and one-half times that in urea.

The content of actual nitrogen in any of these fertilizers will be found printed on the bag.* To figure how much to get in order to obtain a certain weight per acre is a simple matter. If, for example, one plans to use urea (say 44% nitrogen) at a rate of 50 pounds of actual N per acre, then each 80-pound bag will yield 80 x .44 or about 35 pounds of nitrogen. To obtain 50 pounds per acre, then, he will require about 1½ bags of whole fertilizer --50 ÷ 35, or 1.42 bags, to be exact. Another way to work this out is to say that

44% N = 50 lbs/ac, ie; that .44N = 50 lbs/ac.,

so that N = $\frac{50}{44}$ = 114 lbs/ac. = $\frac{114}{80}$ = 1.42 bags.

Unless the grower intends to broadcast the fertilizer by hand or with a grain spreader, he will next have to figure roughly how much each selected tree should get. If he does not do this, he may end up having to put on much more per acre than he intended, in order to ensure that all trees are treated.

Assuming he has decided on a 50-pounds-per-acre treatment, he will therefore estimate the number of stems per acre he plans to treat, and divide this into the poundage of whole fertilizer he intends to apply. Supposing he decides to treat 500 stems in the above example, the average dosage per tree will then work out to

* Or if more than one element is present the ratio of each to the others will be shown and tables will be obtained to calculate the amounts required.

$\frac{(114 \times 16)\text{ oz.}}{500} = \frac{1824}{500} = 3.6$ oz. of whole fertilizer per tree.

This figure is then used as a guide to individual applications. A small tin marked at the proper level will prove useful, especially if it is punched in the bottom to aid sprinkling. Of course if he intends to treat only 100 or 200 trees, the dosage per tree on this basis may be considered too high. Then he should probably use a per-tree basis rather than a per-acre basis. A dosage yielding one or two ounces of actual nitrogen per stem would probably give the desired results safely.

The upper limit of safe fertilization on average stands of balsam fir in Nova Scotia is not yet known. Neither is it known exactly what effects follow when this limit is exceeded. Doubtless the safe level will fluctuate with many factors, such as level of existing nutrients, weather, drainage, season of application, size of trees, break-down rate and grade ratio of the fertilizer, history of the stand, and so on.

However, we can safely assume that here is a limit beyond which damage occurs. What this limit is under given conditions, and what forms the damage may take, will have to be discovered by trial and error. As yet we can only surmise the probable answers from the experience of others.

In Maine it has been found that an overdose of nitrogen on ornamental evergreens produces such soft and succulent growth that they become very attractive to insects and diseases that might not otherwise attack them. Also, such over-dosed trees lack strength to withstand winds and snow. Unfortunately, the extent of the over dosage in these cases could not be ascertained; but the danger is clear.

When?

Concerning the best time of year for applying fertilizers, it should be pointed out here that the fullest take-up and the most marked growth response from nitrogen occurs when the fertilizer is put on in early spring, around the time growth commences. When it is put on later in the growing season, up to 75% of the nutritive value for that growing season may be lost to the tree. This is because the main growth in softwoods takes place before midsummer.

It is true that in succeeding summers a tree will recover part of the fertilizer not used in the first season, but by then much of it may have been lost through leaching--or, if not, may remain to cause a subsequent spurt in height growth. The normal response in softwoods treated with nitrogen and/or porassium is an improvement in foliage the first season, followed by increased diameter and height growth the second and subsequent seasons.

This raises interesting questions for the Christmas tree grower. Although he can get more for his money and achieve more striking results by fertilizing in early spring, should he run the risk of causing excessive growth on the tips and leaders during that summer or the next? Or should he wait until most of the shoot growth is finished, and try for better foliage only, accepting the loss of a portion of his fertilizer investment?

Perhaps he need do neither. Perhaps he can get the results he wants by fertilizing early, but with a smaller dosage. In this way he might achieve a quick improvement in the colour and density of his foliage without getting excessive terminal growth, and without wasting fertilizer. In other words, perhaps 25 pounds per acre of actual nitrogen put on in the spring would do as good a job, with less danger of excess tip growth, as would 50 pounds put on in mid-summer. But the grower must not put on too little, since the cost of the treatment may lie as much in the labor as in the materials. Therefore he must try to get as much benefit from a single application as possible. Some experts advise that it is best to start fertilizing Christmas trees two or three years before they are due to be cut.

Once again, only actual trials will give the answers.

Benefits: How Long?

How long the benefits of fertilizer last in a producing Christmas tree stand is not yet known. Benefits would probably not last as long as those which occur when timber stands are fertilized, for three reasons. Firstly, fast-growing young trees probably use up nutrients at a faster rate; secondly, the rate of harvesting from Christmas tree stands is relatively greater than it is from timber stands; and thirdly, in Christmas tree operations, a smaller proportion of each tree is left behind to "give back" stored nutrients. There is also the difficulty that timber fertilization data usually refer to increased wood production, and not to foliage improvement.

Nevertheless, figures on fertilization benefits in timber stands do give some idea of what to expect. In New York State, plantations of red pine fertilized in 1945 were still making 20% better growth than unfertilized trees in 1965. In Quebec, similar plantations manured 36 years before were still growing faster in 1957 than untreated trees. And Finnish researchers have concluded that the benefits of fertilizing last at least 10 years, "but probably considerably longer". These and other conclusions strongly suggest that a single application of the correct fertilizer should last longer than two or three years under normal conditions.

This again raises the important question of whether the height and diameter growth of fertilized Christmas trees might not gradually accelerate, even though the first application were purposely made after that year's height growth had ceased. Larger stems are not

a real problem to the Christmas tree grower, but too much height can be.

It should be remembered, however, that fertilizer applied one summer produces better foliage that fall, and that by next fall the trees slated for cutting at that time are likely to have absorbed all the benefits they need. The upcoming crop trees may then begin to show some increasing height growth, but it is likely that the fast turnover of nutrients in such young stands will take the momentum out of this growth spurt before it does much harm to crown density, especially when the application has not been heavy.

If growth does not slacken, the grower can probably avoid the unwanted effects by confining treatment to nearly mature trees. Otherwise he may have to shear leaders and laterals for control, and thus increase his costs.

Because nitrogen seems to be the element that growers of Christmas trees should concentrate on, it may be that barnyard or poultry manure, though harder to apply than powdered fertilizer, is all the grower needs to produce the thick green foliage that buyers like. And since many forest soils are over-acidic through the leaching effect of heavy rainfall, lime alone might produce good results in some stands.

Better Needle Retention?

Needle retention after cutting seems to be improved by proper use of fertilizers. Since it has been shown elsewhere that nitrogen treatment increases drought resistance, this would only make sense. Fertilizer is not altogether an artificial stimulus, like a drug or a hormone. It is simply extra plant food, which, if properly prescribed and applied, makes the tree more vigorous and healthy. Being healthier, it naturally becomes less prone to things which affect sickly trees, such as unfavorable weather.

Hardier Trees?

By the same reasoning, treated trees should also prove less prone to the attacks of insects and diseases. The latter effect is important, for if fertilized trees should be found to resist such insects as the Balsam Gall Midge, here would be a valuable defence against what is now a serious periodic threat to the Christmas tree industry. According to some authorities on tree fertilization, treated trees do develop greater resistance to disease in some situations, and probably to insect attack as well.

Does it Pay?

On the question of whether it pays to invest money in fertilizing Christmas trees, only actual trials will give the answers. No doubt in certain situations fertilizing will pay, while in others it will

not. But if one man can treat 100 trees an hour by hand in a thinned and weeded stand, and more with mechanical aid, and if it is found that 50 pounds per acre of nitrogen alone can produce the desired result, then the cost of the fertilizer and labor on one acre will not be much over $20--and much less, if he treats only immediate crop trees.

If the stand has a full stocking of say, 1,000 stems per acre, and he treats every tree, the investment comes to only about 2¢ per tree. Of course, if he does this and harvests only a tenth of the total stocking in any one year, and debits the treatment costs against immediate returns, the investment may not appear profitable in the short run.

Whether it will be profitable over the following few seasons depends on how much this fertilizing raises the market value of his trees, how many trees he harvests a year (and their average size), how much the treatment actually costs, and how long the benefits from one treatment persist. Real answers to such questions can only be found in practice.

Soil Deterioration?

The top foot or so of normal forest soil contains astronomical numbers of bacteria, fungi, and other minute organisms. Many of these are beneficial to tree growth. In fact, it is doubtful whether trees could long remain healthy without them, because they convert unusuable compounds into usuable nutrients, inhibit harmful soil organisms, and aid in water absorption. Some do this in return for nourisnment from the tree roots. The result is a harmonious relationship yielding mutual benefits.

What happens to this relationship when the work of these organisms is supplemented or replaced by artificial measures over a span of years? Or indeed, what happens to the organisms themselves at various levels of fertilization? Since their activity accounts in large measure for the response of crops and trees to fertilizers, these are important questions. Nitrogen, it is known, boosts their numbers many-fold in forest soils, which probably explains the striking response that this element produces. The use of a complete fertilizer can also cause them to thrive.

But little is known about the long-term effects on forest soil organisms of even properly formulated prescriptions, let alone liberal applications. For instance, might a gradual deterioration in the soil result from continual use of fertilizers, particularly the non-nitrogenous ones, in time forcing the Christmas tree grower to rely more and more on them to maintain good colour? No one knows for sure.

SUMMARY

Summing up, fertilizers have a place in Christmas tree cultivation in Nova Scotia. Results here and elsewhere prove this. They offer an effective way to raise the grade of trees, and may with proper development become a valuable adjunct to manual cultivation.

It should be made clear here, however, that nothing in this paper is meant to be taken as recommending general application of fertilizers to Christmas tree stands. It is rather a speculation on the possibilities, and a guide to individual investigation. The technique has possibilities, but, as was pointed out, in some stands the results may be nil. The only definite recommendation that can be made at this time is that it is best to experiment on a small scale before making any large investment.

The Department of Lands and Forests is carrying out further studies on tree nutrition. In time the results of these studies may permit more definite recommendations to be made.

****

Prepared by G. L. Saunders from data and references supplied by L. L. Wright, Extension Forester, Nova Scotia Department of Lands and Forests. Copies available from the Extension Division, Department of Lands and Forests, Box 68, Truro, Nova Scotia.

SOURCES OF FURTHUR INFORMATION

Arcadian Technical Manual for Christmas Tree Farmers, ($2.00), Allied Chemical Corporation, Nitrogen Division, 40 Rector Street, New York, N.Y. 10006, U. S. A.

Fertilizers for Christmas Trees, (free), by Donald P. White; Extension Folder # F-291, Michigan State University, East Lansing, U. S. A.

Fertilizing Natural Stands of Douglas Fir Christmas Trees, (30¢). Extension Bulletin # 585, Washington State University, Pullman, Washington, U. S. A.

How to Fertilize Trees and Measure Response, (50¢), by Stanley P. Gessel, Kenneth J. Turnbull, F. Todd Tremblay; National Plant Food Institute, 1700 K Street, N. W., Washington 6, D. C., U. S. A.

Potash and Magnesium Fertilization of Young Pine and Spruce Trees, (free), by S. O. Heiberg, E. L. Stone, D. P. White; College of Forestry, Syracuse 10, New York, U. S. A.

* * * * * * * * *