AN APPROACH TO FERTILIZATION OF BARE ROOT CONIFER SEEDLINGS

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"Although many techniques of soil and plant analysis are available and can be used to forecast growth and prescribe better soil management practices, the growth response of the crop itself is the only satisfactory criterion of the efficiency of any treatment. Ultimately, of course, the performance of the tree in the forest is the fundamental measure of the degree to which soil management has been successful". [1]

Each Nursery, because of the differences and complexities of the soils and the interactions of soil with water, climate, fertilizer and species of seedling grown, must determine what, how much and when, and how the fertilizer should be applied.

To develop a meaningful and successful fertilizer program, the soils must be sampled. These samples must be sent to a reputable soils testing laboratory to be tested for:

N -Total Nitrogen

P -Phosphorous in P20S lbs/A

K -Potassium in K20 lbs/A

Ca -Calcium in exchangeable CA me/100g

Mg -Magnesium in exchangeable mg me/100g

pH -Acid reaction

OM -Organic matter in per cent exchange capacity me/100g

The results should be returned to the Nursery Manager and his staff with recommendations for fertilizer prescriptions.

When the results and recommendations are received from the laboratory, fertilizer prescriptions can be written. An example of a method to record and vividly illustrate soils test data is to plot this information on a "magic circle". This technique was published in Vol. 2S, No. 1, pp. 1-2, Tree Planter Notes. The authors are K.E. Wojohn and J.G. Iyer.

The first sample shown is an average of the results of 30 samples taken from 20 acres of the Medford Forest Nursery. Samples sent to the soils laboratory in early winter 1977-78 and test results were back with recommendations on Jan. 4, 1978.

Example 1:

The inner circle delineates the minimum levels of fertility factors for a productive conifer nursery soil. The second circle indicates optimum levels of fertility factors. The outer circle indicates the maximum ecologically of

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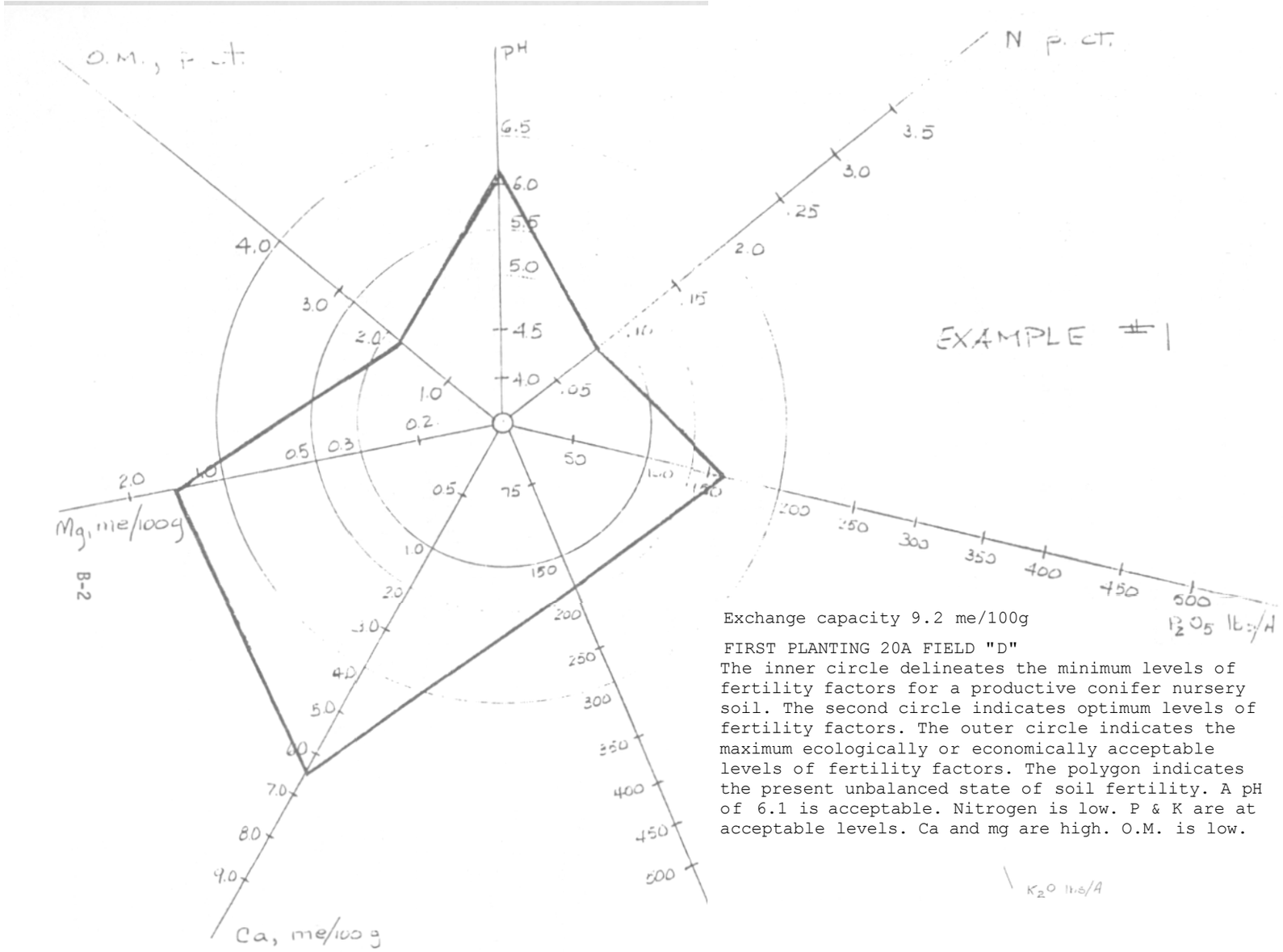
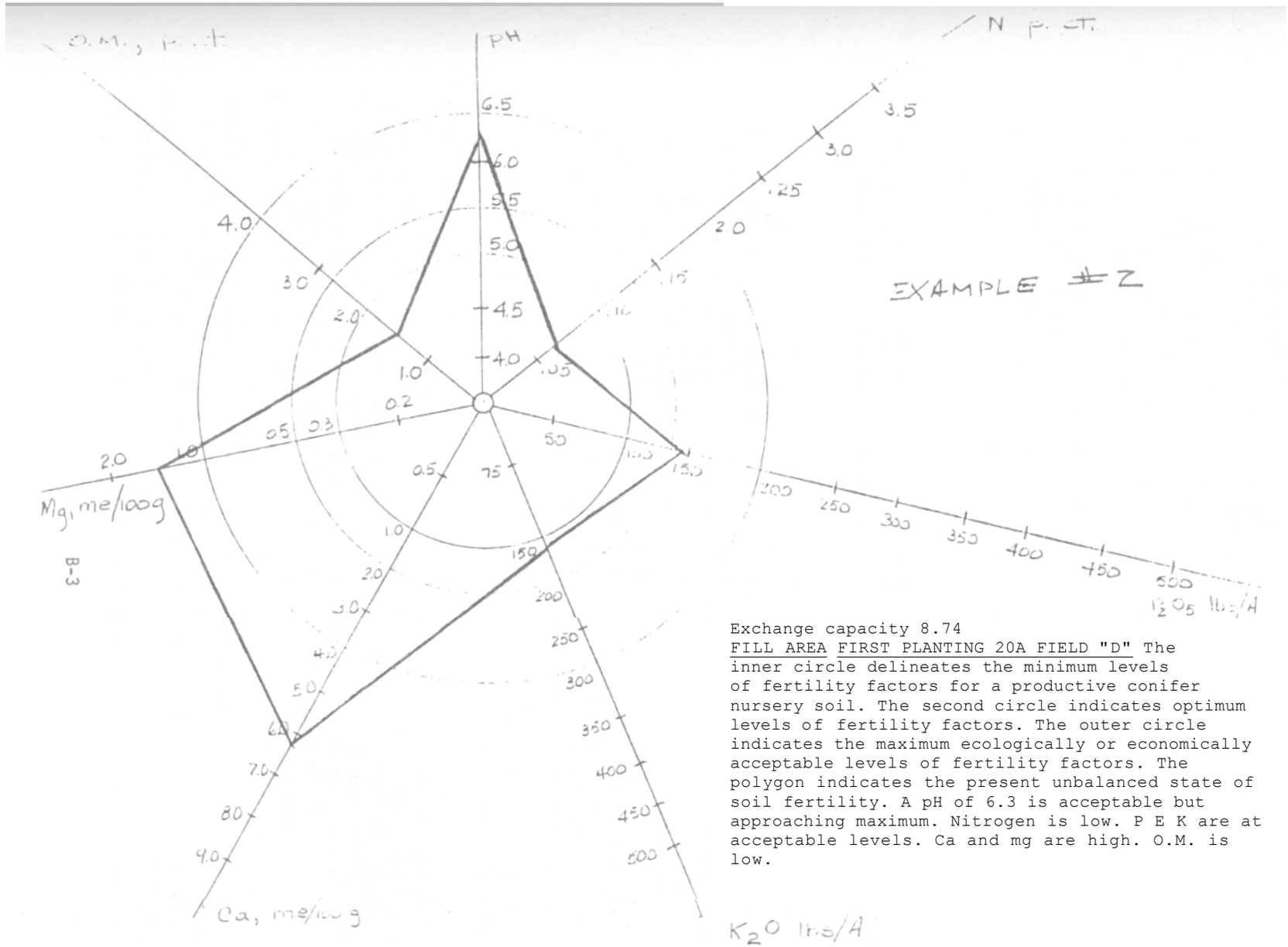
1) Forest Tree Nursery Soil Management and Related Practices; Armson, K.A. and Sadrieka, V., 1974.



Exchange capacity 9.2 me/100g

FIRST PLANTING 20A FIELD "D"

The inner circle delineates the minimum levels of fertility factors for a productive conifer nursery soil. The second circle indicates optimum levels of fertility factors. The outer circle indicates the maximum ecologically or economically acceptable levels of fertility factors. The polygon indicates the present unbalanced state of soil fertility. A pH of 6.1 is acceptable. Nitrogen is low. P & K are at acceptable levels. Ca and mg are high. O.M. is low.



Exchange capacity 8.74

FILL AREA FIRST PLANTING 20A FIELD "D" The inner circle delineates the minimum levels of fertility factors for a productive conifer nursery soil. The second circle indicates optimum levels of fertility factors. The outer circle indicates the maximum ecologically or economically acceptable levels of fertility factors. The polygon indicates the present unbalanced state of soil fertility. A pH of 6.3 is acceptable but approaching maximum. Nitrogen is low. P E K are at acceptable levels. Ca and mg are high. O.M. is low.

economically acceptable levels of fertility factors. The polygon indicates the present unbalanced state of soil fertility in the 20 acres of field "D". A pH of 6.1 is acceptable. Nitrogen is low and ammonium sulphate 21-0-0 was recommended to bring this level up. Applications of ammonium sulphate will help to maintain lower pH levels that are necessary for production of high quality coniferous seedlings. A pH of 5.5 to 6.5 is desirable. P&K are at acceptable levels. Ca and Mg are outside the maximum circle but were classified as entirely adequate and well balanced by the reporting laboratory.

Fortunately the exchange capacity of the soil is rather high. This will moderate the loss of soluble fertilizers and the toxicity of residual eradicants. Organic matter is lower than the recommended 2% and soil amendments are needed to bring these levels up. We plan to add alder or Douglas-fir and Ponderosa pine sawdust during our cover crop year.

Example 2

Unfortunately, there was a portion of the 20 acres that was filled in the leveling process. The fill soil was excavated from our reservoir site and came from parts of the B $ C horizons and not the A horizon that was recommended.

The net results are shown in example 2. Nitrogen is low. pH is approaching the upper limits. The prescription that was recommended was to apply a total of 500 lbs. of ammonium sulphate, 21-0-0. The fertilizer was to be rototilled in prior to sowing. We deviated from this recommendation because high concentrations of N can be detrimental during germination. Dampening off fungi thrive on it. N. is really not utilized by the plant until the root system is beginning to develop. Our prescription was to top dress with 4 applications of 100 lbs. each for a total of 400 lbs. of 21-0-0. Organic matter is low. We will follow the same soil amendment prescription that was given for example 1. I found at the Lucky Peak Nursery in Boise, Idaho that an application of 1 inch of old Douglas-fir and Ponderosa pine sawdust would increase the orgainc matter content by around / of 1%.

P, K, Ca and Mg levels are nearly the same in both examples and I won't comment further on them.

Total amount and type of fertilizer to apply, number of applications, method of applying the material, when to begin adding fertilizers and when to stop are all questions that need to be answered. Our Horticulturist, Nancy Callan, has developed a study plan that will gather data and will ultimately answer some of the questions that I have just raised. The objective of her study is to develop an accurate record of Douglas-fir and Ponderosa pine seedling growth through photographs and dry weight measurements and to correlate seasonal temperature with this growth. Growing degree days will be calculated by subtracting a base temperature from the average daily temperature. This base temperature will be selected by regressing total seedling dry weight on growing degree days calculated with base temperatures on 1.4.8.12.16 and 20 degrees C and selecting the base temperature which appears to be most associated with the beginning of plant growth. Sampling of 1-0 should begin 2 weeks after germination and continue through September - October or when buds are set and dormancy is beginning. Sampling of 2-0 should begin when soil temperatures reach 40-45 degrees in the root zone and continue until buds are set and dormancy is beginning.

Several years will be necessary to establish a temperature - growth curve for any location and for the species involved.

The approach that we took this year was to gather temperature data from a nearby Oregon State Experiment Station and using this information spread our fertilizer applications through the growing season using degree days. The parameters that were established were: 1) Total Fertilizer to be applied to the crop.

300 lbs 21-0-0 to Lodgepole, Jeffrey and Ponderosa pines.

400 lbs 21-0-0 to Douglas-fir, True firs and other species.

2) First application to be made soon after germination is complete, 3) Last application to be made as close to July 1S as possible. The reason for cutting the fertilizer off at that time was to slow the plants down and prepare them for dormancy.

Fertilizer applications were made as follows:
From May 1 - date in mid point of sowing, base temperature 1 degree C or 33.8 degrees F.

	Degree Days C	Interval
Degree days to 1st application 6-S	411.5	
2nd application 6-25	734	322.5
3rd application 7-10	998.5	264.5
4th application 7-25	1318	319.5

As follow-up, we will be sampling the seed bed soil in early winter of this year. Coupled with this we will take samples of seedlings and send them in for tissue analysis. In some situations soil tests can show adequate levels of nutrients but the plant is unable to utilize them. We will be comparing soils and tissue analysis tests to see if we have any nutrient deficiencies developing.

In preparing for the next seedling crop, we planted cayuse oats as a cover crop. Just prior to turning the cover crop under we arranged an overflight of the nursery and pictures were taken to illustrate where deficiencies were in our cover crop. Samples of oats were taken from the deficient areas and sent to Oregon State University for tissue analysis. We will use the data from these tests and from our soils test results to prescribe the fertilizer treatments for next years crop.

Literature Cited

Forest Tree Nursery Soil Management and Related Practices, Armson, K.A. and Sadrieka, V., Ministry of Natural Resources, Division of Forests, Ontario, Canada.

Keeping a Diagramatic Record of Nursery Soils Fertility., Wojohn, K.E.., Iyer, J.G.., Tree Planters' Notes, Vol. 25, No. 1 pp. 1-2

Other Available Literature:

The Growth of White Spruce Seedlings in Relation to Temperature Summation Indices., Armson, K.A., Forestry Chronicle, December 1962.

Temperature Summation Indices and Forest Tree Seedling Growth., Liljalehto, H.A., Student paper, University of Toronto, 1972.