

## **ABSTRACT**

# **PROBLEMS IN TREE NUTRITION**

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The pioneer work in afforesting poor soils has met with some inexplicable failures, instances occurring where, under normal cultural methods, even the least exacting of conifers either failed to grow or gave inconsistent results.

To the late Dr. Rayner in particular must go much of the credit for the knowledge now available on tree nutrition and fertility in difficult moorland soils, and it is impossible to read this book without paying a tribute to her devotion to this hitherto unexplored aspect of afforestation.

In 1932 work on an elaborate research programme sponsored by the Forestry Commission was started by the authors on the dismal moorlands of Wareham Heath in the south of England, and the results of their investigations over many years are recorded in full in this book.

Prior to the carrying out of this research it was generally agreed that mineral deficiencies were not the only limiting factors in nutrition but no information was available to substantiate or refute any of the various biological theories which had arisen. It was suggested that in the process of humus decomposition in these organic soils various substances directly inimical to growth were produced but these were neither identified nor even proven to exist.

The authors have shown that toxic substances are present, that they are of biological origin and that they operate directly by inhibiting fungal growth. These react on the trees, it is believed, by restricting root growth, impeding mycorrhizal formation and generally curtailing the supply of nutrients normally rendered available as a result of fungal activity. An indirect result is the accumulation of raw humus with a high C.N. ratio.

On Wareham Heath Dr. Rayner applied organic compounds that brought about remarkable improvements in plant growth. The improvement was believed to be complex in origin, and highly specialised and intensive research by a team of ecologists, botanists and plant physiologists was undertaken towards obtaining evidence on which the above conclusions are based. Dr. Rayner believed that the quality of the organic substrate in the natural soil was of primary importance and thus the necessity of bringing about a change in the biological activity was apparent to her. It was found that composts removed toxic substances permanently as no other means could, and brought an end to their further production. They operate by modifying the activities of the micro-flora already present, as proved by the enormously accelerated rate of cellulose breakdown etc. Evidence is provided that the basis for these changes lies in the organic constituents of the compost rather than in the inorganic (mineral) nutrients it contains.

The effect of composts on growth of various species of pines is partly attributed to the establishment of mycorrhizal associations with possibly an indirect action through stimulation of soil fungi in general.

Beneficial root fungi are normally present in the soil though often in a dormant state from which they can be released by composts which stimulate short root growth and production of mycorrhizae. Initial growth of short roots may be due to the production of growth promoting substances as a result of the vigorous fungal metabolism.

In the course of the investigations many species and forms of root fungi were identified, some for the first time in these islands. The organisms responsible for the production of toxic substances are, however, still unidentified but a technique of biological analysis was developed that makes it possible to estimate the relative degree of toxicity in any given soil sample. The use of this technique has shown that toxicity occurs in several soils other than Wareham and it is recommended in solving practical problems of afforestation.

In conclusion the authors discuss the bearing of these results on the practical control of fertility and plant nutrients. The importance of differential biological activity in a natural soil is emphasised. Qualitative difference in the resultant products may be determined by the action of varying local conditions on these activities at any stage and fertility depends on the maintenance of correct biological balance. Addition of mineral nutrients, aeration of the soil by mechanical treatment etc., while effective to a degree, cannot of themselves guarantee permanent amelioration. Biological activity must be guided along certain lines, e.g. by control of the litter in the forest, selective planting etc. Where degenerative changes have progressed beyond a certain point it may be easier and quicker to initiate a change by application of suitable organic materials.

Finally in this very complex problem the conclusion is drawn that there is great need for further research.

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