

and deepfelt goodwill towards the forests. It is not only illogical that this general feeling of goodwill should be working against the forester instead of for him—it is also prejudicial to good forestry and, hence, to the nation as a whole.

In practical terms, what can be done to correct the position? I think there is a great deal, although the onus of doing it will fall on foresters, who are already generally fully occupied with their more immediate problems. It would call for a display of kneeness and idealism to a greater degree than has been evident in the past; but these qualities, after all, should not be foreign to the practising forester. I have some concrete suggestions myself which I hope to submit at the next meeting of the Institute of Foresters. In the meantime I am addressing this letter in the hope that other members will express their views and that, as a result, this important matter will be accorded the attention it deserves.

I am, etc.,

A. P. THOMSON.

To the Editor,

N.Z. Journal of Forestry.

Mycorrhiza.

Sir,

Do we know enough about mycorrhiza and its significance in regard to forestry? Or should I say, do we make sufficient use of what little we do know of this confusing relationship between fungus and tree root? Without pretending to know anything of the more complex scientific aspects of the problem which for the past sixty years has caused so much controversy, confusion and disagreement, or claiming to know anything of the technique of pure culture, which is the mycologist's job, but having read with interest of soil inoculations carried out in many parts of the world, I put forward the following notes of personal results and correlated reading.

There are accounts of fourteen nursery failures in Western Australia alone, where afforestation on a large scale is still in progress. In each nursery seeds of pines germinated normally and produced seedlings which at first were healthy, but later, except for an occasional group of seedlings, the plants ceased growth, turned yellow, and thereafter gradually died (Kessell 1927). Although the trouble was first diagnosed as a nutrient deficiency, it was found that soil fertilization was of only temporary benefit. An examination of the roots revealed no pathological conditions, but it was noticed that, except for the few groups or islands of seedlings which grew healthily, the coralloid roots (mycorrhizas) which nurserymen in other regions had learned to associate with healthy stock, were absent. Small

quantities of soil from established nurseries in other regions were worked into a few of the seed beds and the pines in these beds recovered and thereafter grew normally. Their recovery was accompanied by the development of mycorrhiza on their root systems. Subsequent inoculations of seed beds in all nurseries saved the entire afforestation project from abandonment.

An identical experience was recently described from Southern Rhodesia where a new nursery in an unforested area was finally saved from abandonment by seed-bed inoculations (Anonymous 1931). In Java and Sumatra (Roeloffs 1930) plantations of seedling stock which lacked mycorrhiza have been saved by subsequent interplanting with mycorrhizal seedlings. These three cases were quoted by Hatch (1937) in his book "The Physical Basis of Mycotrophy in *Pinus*."

For a long time my own theory had been that mycorrhiza formers for Douglas fir were present in only one of the eight nurseries at Golden Downs Forest and that all healthy Douglas fir stock planted out between 1929 and 1933 came from this particular nursery, and I reported to this effect.

Others must have seen that there was at least presumptive evidence of this, for in 1939 a small quantity of this soil (half a kerosene case) was sent to Eyrewell Forest to inoculate seed beds which unfortunately had already been sown with 30 lbs. of Douglas fir seed. The inoculation was carried out by working into the narrow spaces between the seed bands small amounts of this soil at intervals over the whole area sown. It was not until the second year that any result was seen and then the only difference was in the colour of these trees which showed up as small green islands among the unhealthy yellow appearance of the rest of the bed. As this was not very convincing, no further notice was taken and the trees were lifted in the usual way from one end of the bed and carried on in sequence as they came, the green trees with the yellow. The trees were planted out at Ashley Forest in 1941 when 151 acres were established with this stock, but it was not until 1943 that it became very noticeable that odd lines or parts of lines were totally different from those alongside. This appeared all over the compartment with well grown, dark green trees with normal length of needle, growing in one row against small sickly yellow trees with short needles from $\frac{1}{4}$ to $\frac{1}{2}$ inch long in adjoining rows.

Again at Ashley in November, 1940, 3 lbs. of Douglas fir seed were sown in two beds. The first bed was not treated but the second was divided into three and was treated (a) with rotted stable manure, (b) with manure and mycorrhizal soil, (c) with mycorrhizal soil only. A very poor strike was obtained and as the trees were so sparse it was decided to lift and line them out in one nursery break. This work was carried out in October, 1941, and the following are the number of trees lined out:—Not treated 3830, (a) 1,100, (b) 700, (c) 1,560. The following month had the lowest rainfall recorded for 18 years,

in fact the first significant rain was not until 16th December, and by this time most of the trees appeared quite dead. However, the only trees that survived the summer were those from plot (c); 1,200 healthy green trees being lifted and planted out in August, 1942. These have since retained their colour and show normal growth.

At the time no reason could be given for all trees but those in (c) dying, but I have since read that "In Australia direct benefit is attributed to Monterey pine by mycorrhiza, in that under drought conditions, while the absorbing tips of roots collapse and cannot function again, the mycorrhiza do not collapse and they become active immediately after rain, making water absorption possible at once" (Cromer 1935). This seems to answer the Ashley question exactly.

By far the most striking experiment carried out was when sowing 14 lbs. of Douglas fir seed at Ashley in October, 1941. Two half beds out of ten sown were inoculated with soil from a healthy stand of the same species growing at North Loburn. Again no difference was seen in the first year, but in the second year the appearance of the inoculated trees was astounding, they being taller, a healthy dark green and long needled against the yellow, short needles of the remainder of the beds. The difference was so pronounced that it could be seen at a distance of five chains. In 1943, three half beds were lifted and planted in one block, the untreated trees being planted between the two treated beds, the three lots being carefully marked. To-day a stranger can walk through these trees and stop on the line dividing the two lots. Not all the trees have remained green among the inoculated lots, but only very odd trees show any sign of becoming normal among the control plot.

Other experiments have been carried out but it is too early to see any definite results at present. However, in my opinion, this should not deter forest nurserymen from at least trying to establish mycorrhiza formers in every nursery, more especially the new project when soil from a vigorous stand of the same or a closely related species should be worked into the seed beds.

I am, etc.,

R. J. LAWRENCE.