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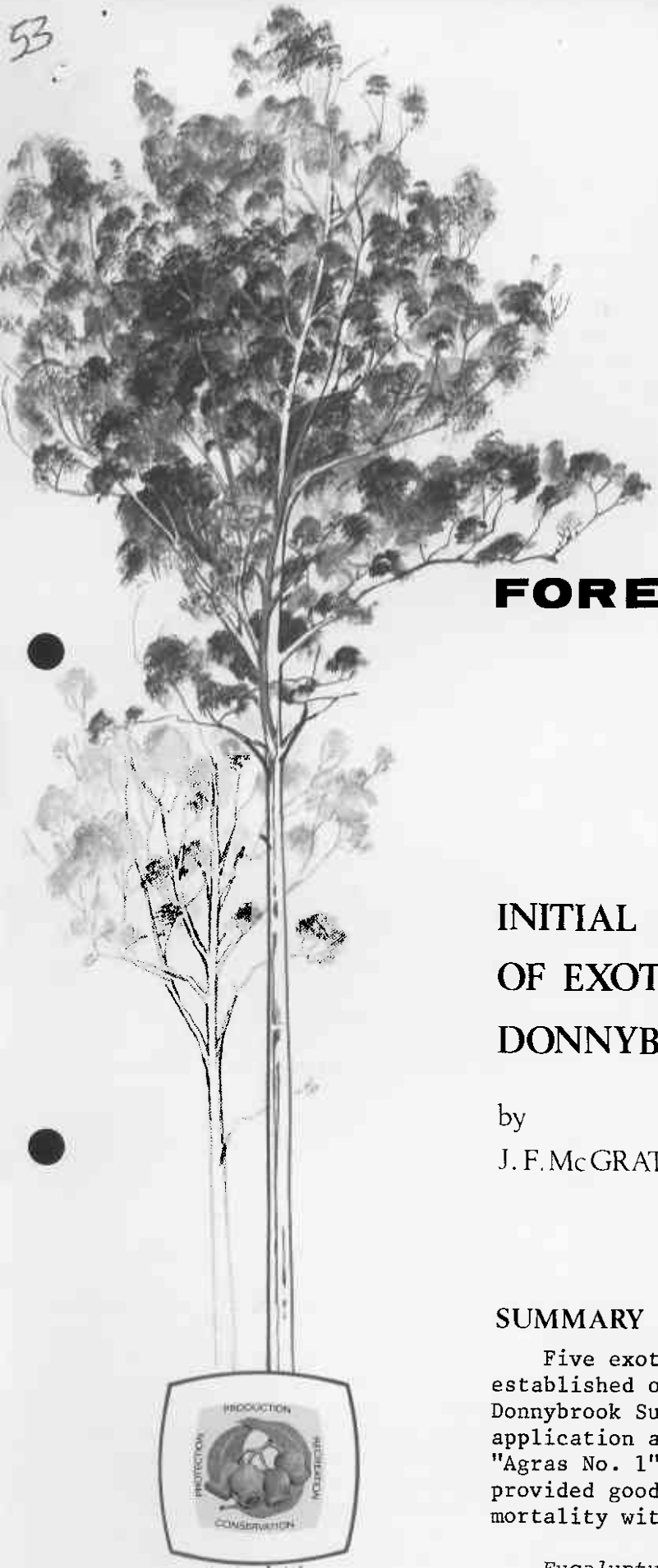

FORESTS DEPARTMENT
OF WESTERN AUSTRALIA

INITIAL FERTILISER REQUIREMENTS OF EXOTIC EUCALYPTS ON THE DONNYBROOK SUNKLAND

by
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SUMMARY

Five exotic eucalypt species were successfully established on a sandy loam soil typical of the Donnybrook Sunkland. The optimum initial fertiliser application appeared to be 100 g per tree of "Agras No. 1" (7.9% P, 18% N). This application provided good initial growth rates and low seedling mortality with all species.

Eucalyptus globulus grew the fastest, but appeared to require potassium at high rates of nitrogen and phosphorus fertilisation. However, a more comprehensive fertiliser trial is necessary to accurately determine the fertiliser requirements of eucalypts on the Sunkland soils.

INTRODUCTION

The proposed Donnybrook Sunkland pine plantation will consist of cells of *Pinus radiata* D. Don. separated by hardwood buffer zones (Forests Department of Western Australia, 1975). Large areas of the Sunkland are affected by jarrah dieback disease caused by the pathogen *Phytophthora cinnamomi* Rands, and the forest in these areas is severely degraded. Dieback-resistant exotic eucalypts could be used to rehabilitate hardwood buffers affected by the disease, and return the forest to a productive condition. However, soil fertility in the Sunkland is so poor that no exotic eucalypt will grow at an economic rate without the application of fertiliser (F.H. McKinnell, personal communication).

Responses to nitrogen and phosphorus fertilisation have been obtained with various eucalypts. Cromer (1971) showed that nitrogen application increased the height growth of a range of eucalypts grown on former farm land in Gippsland, Victoria. Phosphorus alone did not produce a growth response in any species, but *Eucalyptus globulus* showed a positive nitrogen-phosphorus interaction. A similar interaction has been noted by other researchers, for example Loneragan and Loneragan (1964) working with *E. diversicolor* at Manjimup, Western Australia, and McIntyre and Pryor (1974) using *E. grandis* at Coffs Harbour, New South Wales.

In view of the possible role of exotic eucalypts in the Donnybrook Sunkland, a fertiliser trial was established to determine which of five dieback-resistant species grew best under Sunkland conditions. Three compound nitrogen and phosphorus fertilisers were evaluated to determine which was the most suitable for eucalypt growth, and to determine the optimum level of application for each fertiliser.

METHOD

The trial is situated in the Jarrahwood pilot plantation in the north-east section of the Donnybrook Sunkland. The soil is a typical Mungite sandy loam (Smith, 1951); there is a grey sandy loam at the surface, and the colour becomes lighter and the texture heavier with increasing depth.

The trial was established in 1975 after clearing, windrowing and burning in 1974. The site was ploughed and mounded before planting. The eucalypt seedlings, which had been grown in pots, were planted in the first week of June 1975, and the initial fertiliser treatments were applied in August 1975.

The five species used in the trial were *E. globulus* Labill., *E. microcorys* F. Muell., *E. cypellocarpa* L. Johnson, *E. oreades* R.T. Bak. and *E. resinifera* Sm. These were selected as the most promising after earlier species screening trials. Three compound nitrogen and phosphorus fertilisers were used: "Agras No. 1" (18% N, 7.9% P, 16% S), "Vigran 9-9-9" (9% N, 4% P, 7.5% K) and "Boost Crop" (4% N, 3.5% P, 2.5% K). The nitrogen in all three fertilisers is in the form of ammonium compounds. The availability of phosphorus in the three fertilisers varies. All the phosphorus in "Agras No. 1" is either water- or citrate-soluble. Most of the phosphorus in "Vigran 9-9-9" is either water- or citrate-soluble with a small proportion acid-soluble. The reverse is true of "Boost Crop", in which most of the phosphorus is in an acid-soluble form. Each fertiliser was applied at rates of 50, 100, 200 and 400 g per tree. No control (zero application) was included because experience has shown that without fertilisation, exotic eucalypts do not grow on the Sunkland (F.H. McKinnell, personal communication).

Each species was planted in a block separate from the others. Within each block the twelve treatments (3 fertilisers x 4 applications) were replicated four times in line plots of 13 trees each, and the individual treatments were allocated randomly within the replicates. Where possible, ashbeds were avoided because their effects on tree growth would have masked those of the fertiliser treatments.

The *E. globulus* seedlings grew very well at first, but by June 1976 a high proportion had developed deformed purple-coloured leaves and leaf drop occurred on some plants. A broadcast application of "Agras No. 1" at the rate of 500 kg·ha^{-1} on the *E. globulus* block in September 1976 resulted in the rapid disappearance of these symptoms.

Percentage survival and tree height were measured in March 1976, and tree height was remeasured in April 1977.

RESULTS

Percentage survival of some species was reduced ($p < 0.05$) by the application of large amounts of some of the fertilisers (Fig. 1). "Agras No. 1" was the most toxic of the three fertilisers tested, followed by "Vigran 9-9-9" and then "Boost Crop". The degree of toxicity appeared to be related to the nitrogen and phosphorus content of the fertilisers.

E. globulus was the least sensitive to high levels of fertiliser, followed by *E. cypellocarpa*, *E. microcorys*, *E. resinifera* and *E. oreades* in ascending order of sensitivity. The effects of high rates of fertiliser application on *E. globulus* and *E. cypellocarpa* were of no practical significance; however, for the other three species the reduction in survival (approximately 20%) is unacceptably high.

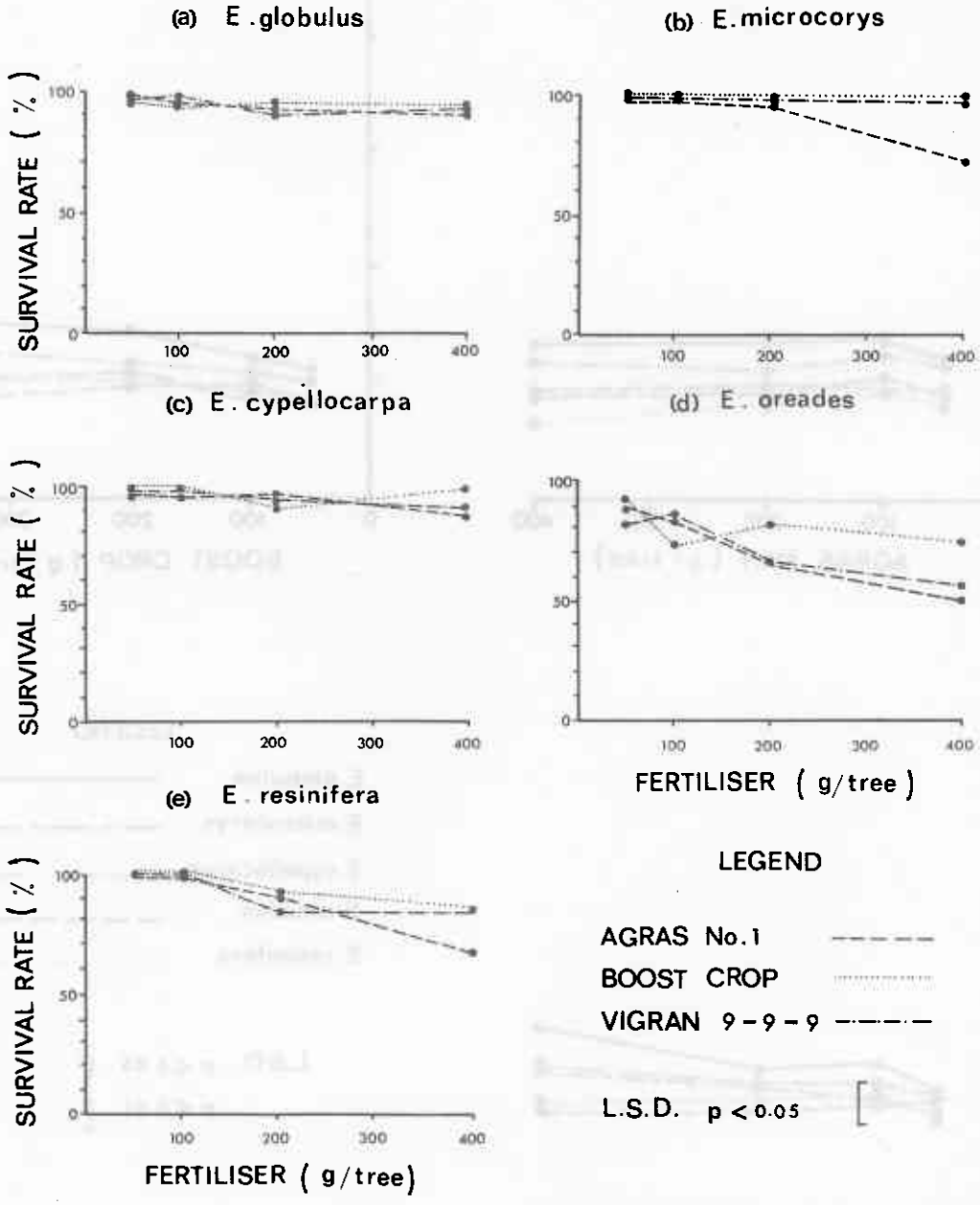

Figure 1: Percentage survival of five exotic eucalypt species (age 1 year) at various levels of fertiliser application.

The mean height data one year after planting (Fig. 2) show trends similar to those shown by the percentage survival data. At the two highest levels of application of "Agras No. 1" the growth of all species was depressed relative to the optimum level of application of this fertiliser which is 100 g per tree. The high levels of "Vigran 9-9-9" depressed the growth of only the most sensitive species, *E. resinifera* and *E. oreades*, while high levels of "Boost Crop" reduced the growth of *E. oreades* only. With all species except *E. oreades* and *E. resinifera*, maximum growth was not reached, even with the 400 g applications of "Vigran 9-9-9" and "Boost Crop".

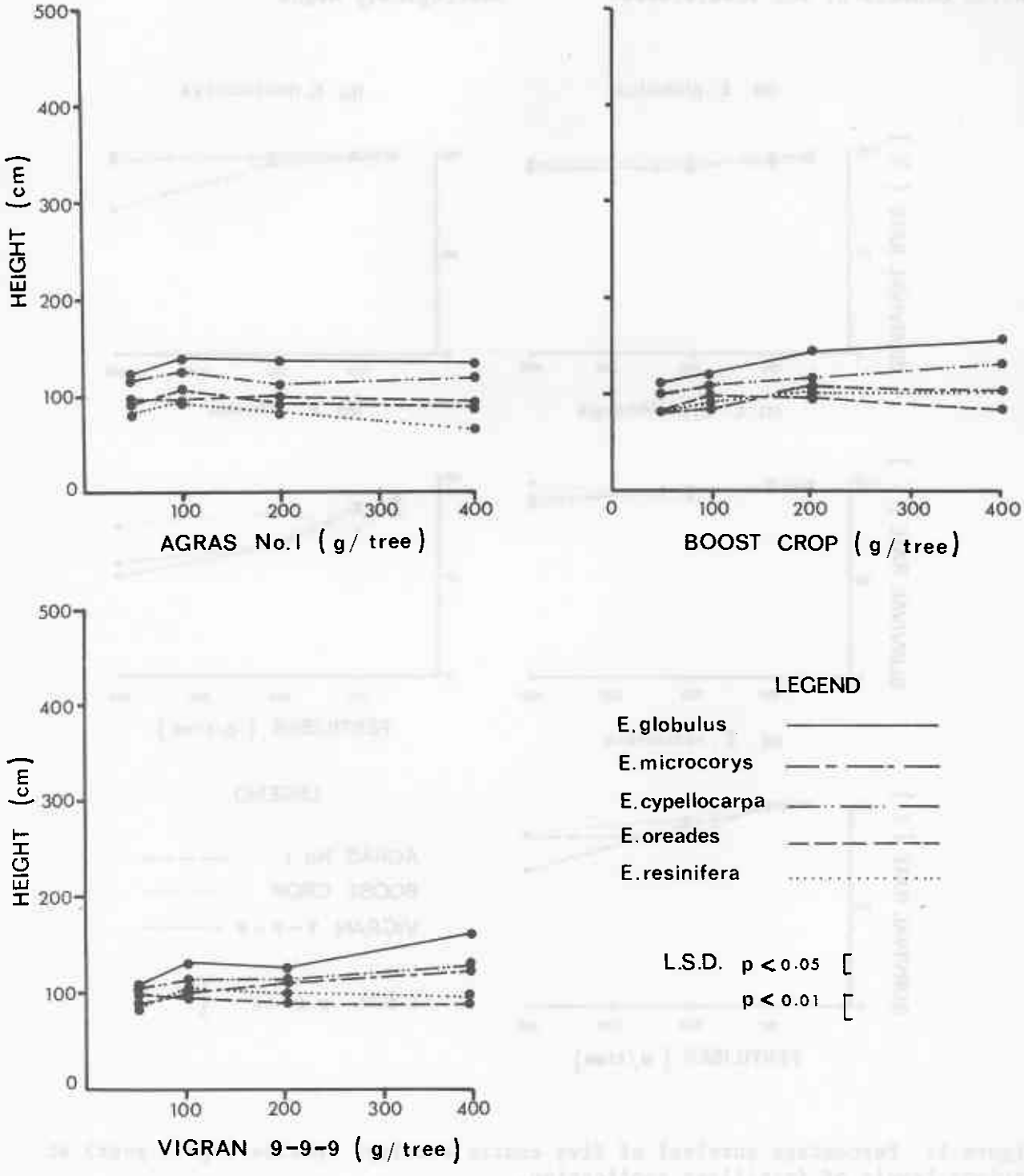

FIGURE 2: Growth response (mean heights) of five exotic eucalypt species to various rates of application of three different fertilisers - 1976 data.

E. globulus showed the best height growth in the first year, followed by *E. cypellocarpa*, *E. microcorys*, *E. resinifera* and *E. oreades*. The growth results for the second year (Fig. 3) followed the same trends. With the exception of the 400 g per tree "Vigran 9-9-9" application to *E. globulus*, "Agras No. 1" at 100 g per tree provided the best growth in the first two years.

The large increase in height growth of *E. globulus* in the second year is probably due to the application at age 1 year of 500 kg·ha^{-1} "Agras No. 1". This refertilisation makes it impossible to compare the growth of *E. globulus* with that of the other four species after the first year.

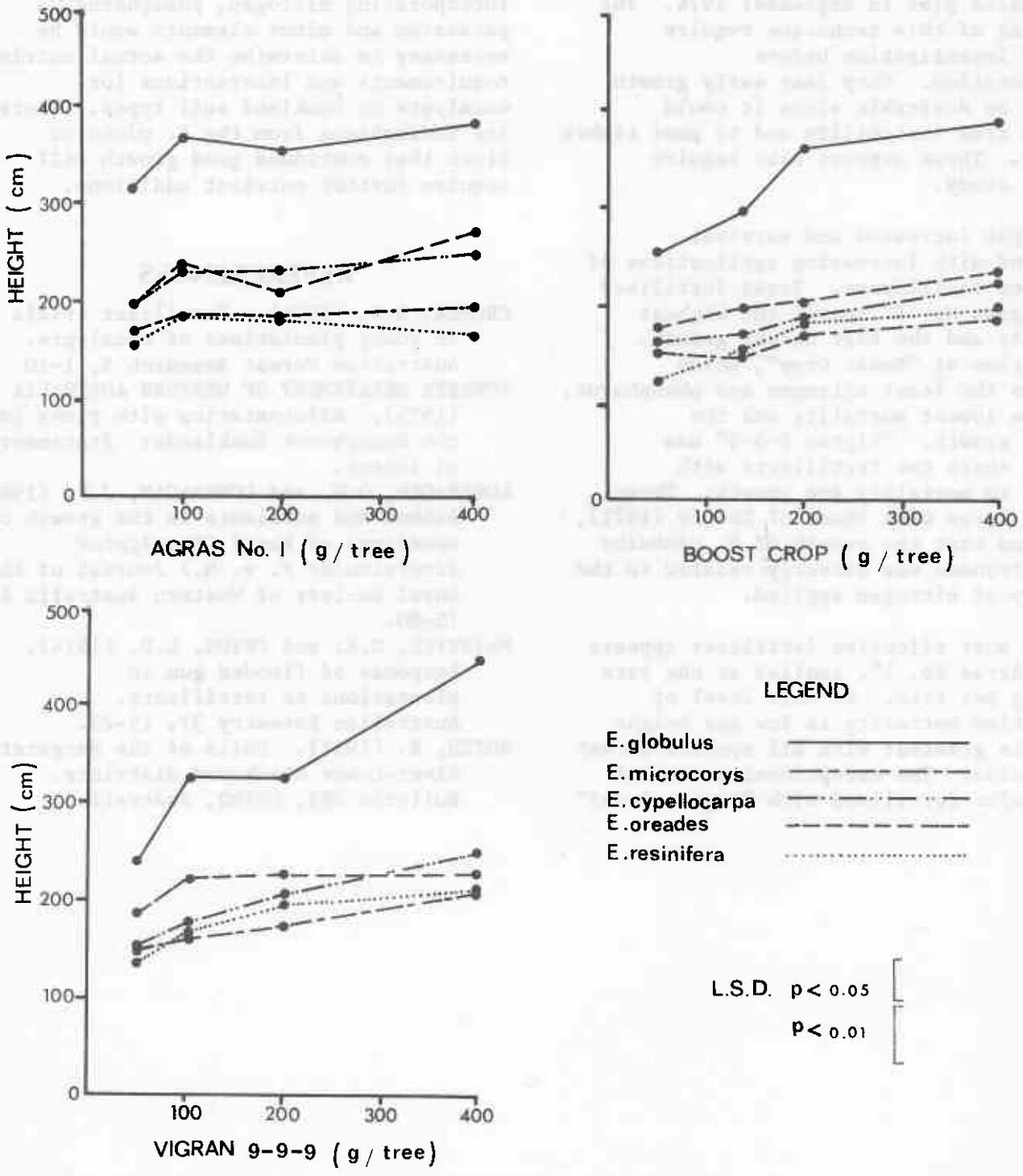

FIGURE 3: Growth response (mean heights) of five exotic eucalypt species to various rates of application of three different fertilisers - 1977 data.

DISCUSSION

The results indicate that with fertilisation, exotic eucalypts can be successfully established on the Sunkland. Although the trial monitored only the first two years' growth, it appears that of the five species, *E. globulus* responds most readily to fertiliser application. However, such fast growth relies on heavy applications of fertiliser, as shown by the need to refertilise the *E. globulus* plot in September 1976. The economics of this technique require further investigation before implementation. Very fast early growth may not be desirable since it could lead to tree instability and to poor timber quality. These aspects also require further study.

Height increased and survival decreased with increasing applications of the three fertilisers. Trees fertilised with "Agras No. 1" showed the highest mortality and the best height growth. Application of "Boost Crop", which contains the least nitrogen and phosphorus, gave the lowest mortality and the slowest growth. "Vigran 9-9-9" was between these two fertilisers with respect to mortality and growth. These results agree with those of Cromer (1971), who found that the growth of *E. globulus* and *E. regnans* was directly related to the quantity of nitrogen applied.

The most effective fertiliser appears to be "Agras No. 1", applied at the rate of 100 g per tree. At this level of application mortality is low and height growth is greatest with all species except *E. globulus*. The exceptional growth of *E. globulus* fertilised with "Vigran 9-9-9" at the rate of 400 g per tree suggests that on Sunkland soils this species may require potassium at high levels of nitrogen and phosphorus fertilisation. Its growth is even more striking when it is considered that the quantities of nitrogen and phosphorus in a 400 g per tree application of "Vigran 9-9-9" are equivalent to those in a 200 g per tree application of "Agras No. 1".

A more comprehensive trial incorporating nitrogen, phosphorus, potassium and minor elements would be necessary to determine the actual nutrient requirements and interactions for eucalypts on Sunkland soil types. There are indications from the *E. globulus* block that continued good growth will require further nutrient additions.

REFERERENCES

CROMER, R.N. (1971). Fertilizer trials in young plantations of eucalypts. Australian Forest Research 5, 1-10.

FORESTS DEPARTMENT OF WESTERN AUSTRALIA (1975). Afforestation with Pines in the Donnybrook Sunklands: Statement of Intent.

LONERAGAN, O.W. and LONERAGAN, J.F. (1964). Ashbed and nutrients in the growth of seedlings of karri (*Eucalyptus diversicolor* F. v. M.) Journal of the Royal Society of Western Australia 47, 75-80.

McINTYRE, D.K. and PRYOR, L.D. (1974). Response of flooded gum in plantations to fertilisers. Australian Forestry 37, 15-23.

SMITH, R. (1951). Soils of the Margaret River-Lower Blackwood districts. Bulletin 262, CSIRO, Australia.