

RATES OF PHOSPHATE ROCK AND THE EARLY
GROWTH OF RADIATA PINE

by

M.F. Skinner
E.D. Robertson

Report No. 20

December 1987

Confidential to members of the National Forest Fertilising Cooperative
This material is unpublished and must not be cited as a literature reference

FRI/INDUSTRY RESEARCH COOPERATIVES

EXECUTIVE SUMMARY

This report summarises the age 4 results and should be read alongside National Forest Fertilising Cooperative Report No. 14 issued September 1987.

- * On podzolised sands and clays the evidence suggests that rock phosphate application rates can be reduced to a minimum of 56 kg P/ha.
- * On improved pasture soils (fertilised with superphosphate) and converted to radiata pine, phosphate fertiliser is not required at time-of-planting.

TRIAL AK 925/1

ESTABLISHED

1983 Parengarenga Forest, Te Kao, Carter Holt Industries.

TREATMENTS

1. Control
2. 25 kg P/ha
3. 56 kg P/ha
4. 125 kg P/ha
5. 280 kg P/ha
6. 80 g DAP/seedling

Refertilised 1986 with N, P and K at 90:100 kg/ha.

RESULTS

1. Growth

The results for tree heights and diameters are presented in Figures 1 and 2. The response curve to P is essentially flat across all rates. The average height for phosphate rock fertilised trees was 295 cm at age 4. DAP treated trees showed a marked response (to 371 cm), presumably due to the N component.

2. Nutrition

The 1987 (age 4) foliage results are shown below (extracted from NFFC Report No. 13 compiled by A.T. Sims).

| Treatment | Refert. | Concentration (%) | | |
|-------------|---------|-------------------|------|------|
| | | N | P | K |
| Control | No | - | 0.09 | 0.32 |
| | Yes | - | 0.13 | 0.57 |
| 25 kg P/ha | No | - | 0.09 | 0.28 |
| | Yes | - | 0.13 | 0.45 |
| 56 kg P/ha | No | - | 0.12 | 0.21 |
| | Yes | - | 0.13 | 0.45 |
| 125 kg P/ha | No | - | 0.12 | 0.22 |
| | Yes | - | 0.15 | 0.59 |
| 280 kg P/ha | No | - | 0.14 | 0.22 |
| | Yes | - | 0.15 | 0.53 |
| DAP | No | - | 0.10 | 0.23 |
| | Yes | - | 0.12 | 0.52 |

To maintain adequate foliar P concentration beyond age 4, 56 kg P/ha is the minimum rate of application of GPR at establishment. Refertilisation with K at age 3 is essential to maintain foliar K concentrations at or above 0.5% by age 4. At the time of writing data on foliar N concentration is not available.

TRIAL AK 925/2**ESTABLISHED**

1983 Cape Kaikari Forest, Northern Pulp Ltd.

TREATMENTS

1. Control
2. 25 kg P/ha
3. 56 kg P/ha
4. 128 kg P/ha
5. 280 kg P/ha
6. 80 g DAP/seedling

Refertilised 1986 with N, P and K at 90:100:100 kg/ha.

RESULTS

1. Growth

The data for tree heights and diameters are presented in Figures 3 and 4. Refertilising trees at age 3 did not improve growth through to age 4. The reasons for this are clear from the nutrition data presented below. The optimum rate from establishment appears to be 56 kg P/ha (tree heights at 423 cm, compared with 328 cm for the DAP treatment), although all treatments are now acutely P deficient. This issue is followed up in the "Discussion" section.

2. Nutrition

The 1987 foliage results are shown below (extracted from NFFC Report No. 13 compiled by A.T. Sims).

| Treatment | Refert. | Concentration (%) | | |
|-------------------|---------|-------------------|------|-----|
| | | N | P | K |
| Control | No | 2.0 | 0.05 | 0.7 |
| | Yes | 1.6 | 0.08 | 0.6 |
| 25 kg P/ha | No | 1.3 | 0.06 | 0.4 |
| | Yes | 1.4 | 0.08 | 0.6 |
| 56 kg P/ha | No | 1.3 | 0.06 | 0.3 |
| | Yes | 1.2 | 0.09 | 0.4 |
| 125 kg P/ha | No | 1.2 | 0.08 | 0.2 |
| | Yes | 1.2 | 0.09 | 0.4 |
| 280 kg P/ha | No | 1.0 | 0.09 | 0.2 |
| | Yes | 1.2 | 0.09 | 0.3 |
| 80 g DAP/seedling | No | 1.4 | 0.05 | 0.5 |
| | Yes | 1.5 | 0.08 | 0.6 |

All treatments are now deficient in N, and acutely deficient in P and K, including all treatments refertilised 12 months previously with N, P, and K.

3. Discussion

The results of this trial are extreme. N, P and K are now growth limiting in all treatments. At the highest rate of applied P, 280 kg/ha, the fertiliser P cannot have moved from the profile. It is likely that there has been interference in P uptake. The source of interference is not yet known, but since K concentration are extremely low; the lack of K may be interfering with P uptake. Another possibility lies with Mn interference. This element is being checked on.

TRIAL AK 925/3**ESTABLISHED**

1983 Opoteke West, New Zealand Forest Products (Shell Forestry).

TREATMENTS

1. Control
2. 25 kg P/ha
3. 56 kg P/ha
4. 125 kg P/ha
5. 280 kg P/ha
6. 80 g DAP/seedling

Refertilised 1986 with N, P and K at 90:100:100 kg/ha.

RESULTS

1. Growth

The data for height and diameters are presented in Figures 5 and 6. Fertiliser applied at establishment has, to age 4, not improved growth over the unfertilised controls.

2. Nutrition

The 1987 foliage results (extracted from NFFC Report No.) are shown below.

| Treatment | Refert. | Concentration (%) | | |
|-------------------|---------|-------------------|------|-----|
| | | N | P | K |
| Control | No | 1.5 | 0.10 | 0.7 |
| | Yes | 1.4 | 0.13 | 0.8 |
| 25 kg P/ha | No | 1.5 | 0.11 | 0.7 |
| | Yes | 1.6 | 0.14 | 0.8 |
| 56 kg P/ha | No | 1.5 | 0.12 | 0.7 |
| | Yes | 1.6 | 0.14 | 0.8 |
| 125 kg P/ha | No | 1.5 | 0.12 | 0.7 |
| | Yes | 1.5 | 0.14 | 0.8 |
| 280 kg P/ha | No | 1.5 | 0.14 | 0.7 |
| | Yes | 1.5 | 0.14 | 0.8 |
| 80 g DAP/seedling | No | 1.5 | 0.10 | 0.7 |
| | Yes | 1.5 | 0.12 | 0.8 |

Unfertilised trees are now showing foliar P at 0.10%, indicating a loss of growth compared with fertilised trees. Growth differences should now become apparent.

TRIAL WN 356**ESTABLISHED**

1983 Upper Hutt, Wellington Regional Council.

TREATMENTS

1. Control
2. 25 kg P/ha
3. 56 kg P/ha
4. 125 kg P/ha
5. 280 kg P/ha
6. 80 g DAP/seedling

Refertilised 1986 with N, P and K at 90:100:100 kg/ha.

RESULTS

1. Growth

The data at age 4 is presented in Figures 7 and 8. Trees fertilised at establishment with either phosphate rock or DAP showed no improvement in growth over unfertilised trees.

2. Nutrition

The 1987 (age 4) data (extracted from NFFC Report No. 18) are shown below.

| Treatment | Refert. | Concentration (%) | | |
|-------------------|---------|-------------------|------|------|
| | | N | P | K |
| Control | No | 1.7 | 0.15 | 0.73 |
| | Yes | 1.7 | 0.16 | 0.80 |
| 25 kg P/ha | No | 1.6 | 0.15 | 0.71 |
| | Yes | 1.7 | 0.16 | 0.71 |
| 56 kg P/ha | No | 1.7 | 0.15 | 0.74 |
| | Yes | 1.7 | 0.17 | 0.78 |
| 125 kg P/ha | No | 1.6 | 0.15 | 0.67 |
| | Yes | 1.6 | 0.15 | 0.74 |
| 280 kg P/ha | No | 1.6 | 0.16 | 0.61 |
| | Yes | 1.6 | 0.17 | 0.73 |
| 80 g DAP/seedling | No | 1.7 | 0.15 | 0.65 |
| | Yes | 1.7 | 0.17 | 0.80 |

Foliar N, P and K are well in excess of deficiency and in accord with the lack of fertilised response.

3. Discussion

Bray P analyses for the site indicated that a P response could be expected. A modification to the Bray extraction technique reversed this conclusion. This revised outcome is in line with the growth data.

FIGURE 1

THE EFFECT OF FERTILISER TREATMENT ON HEIGHT GROWTH

AK925/1

LSD P=0.05 AGE4 40.7cm, AGE5 61.4cm

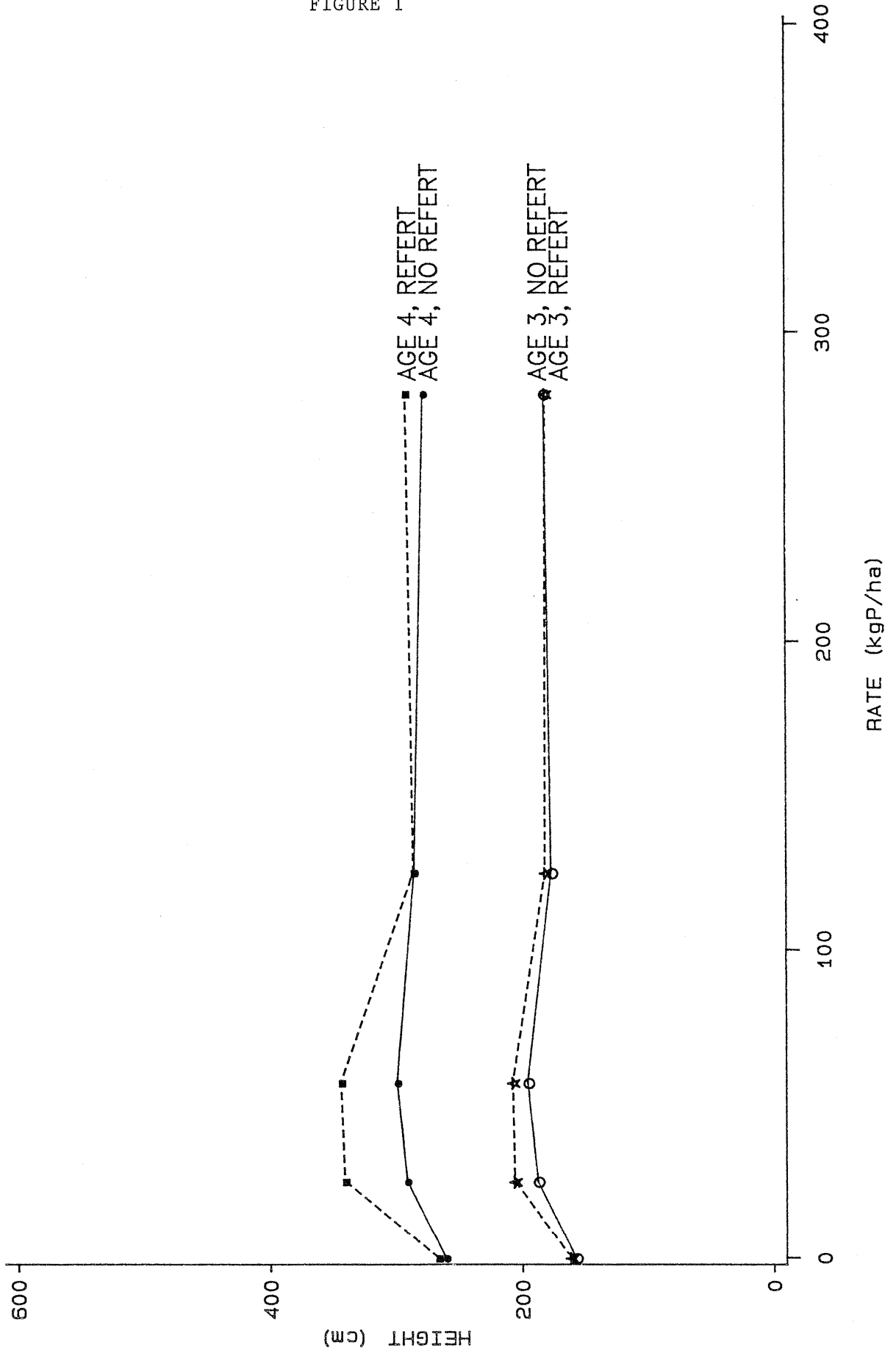


FIGURE 2

THE EFFECT OF FERTILISER TREATMENT ON DIAMETER GROWTH

AK925/1

LSD P=0.05 AGE4 11.5mm, AGE5 15.2mm

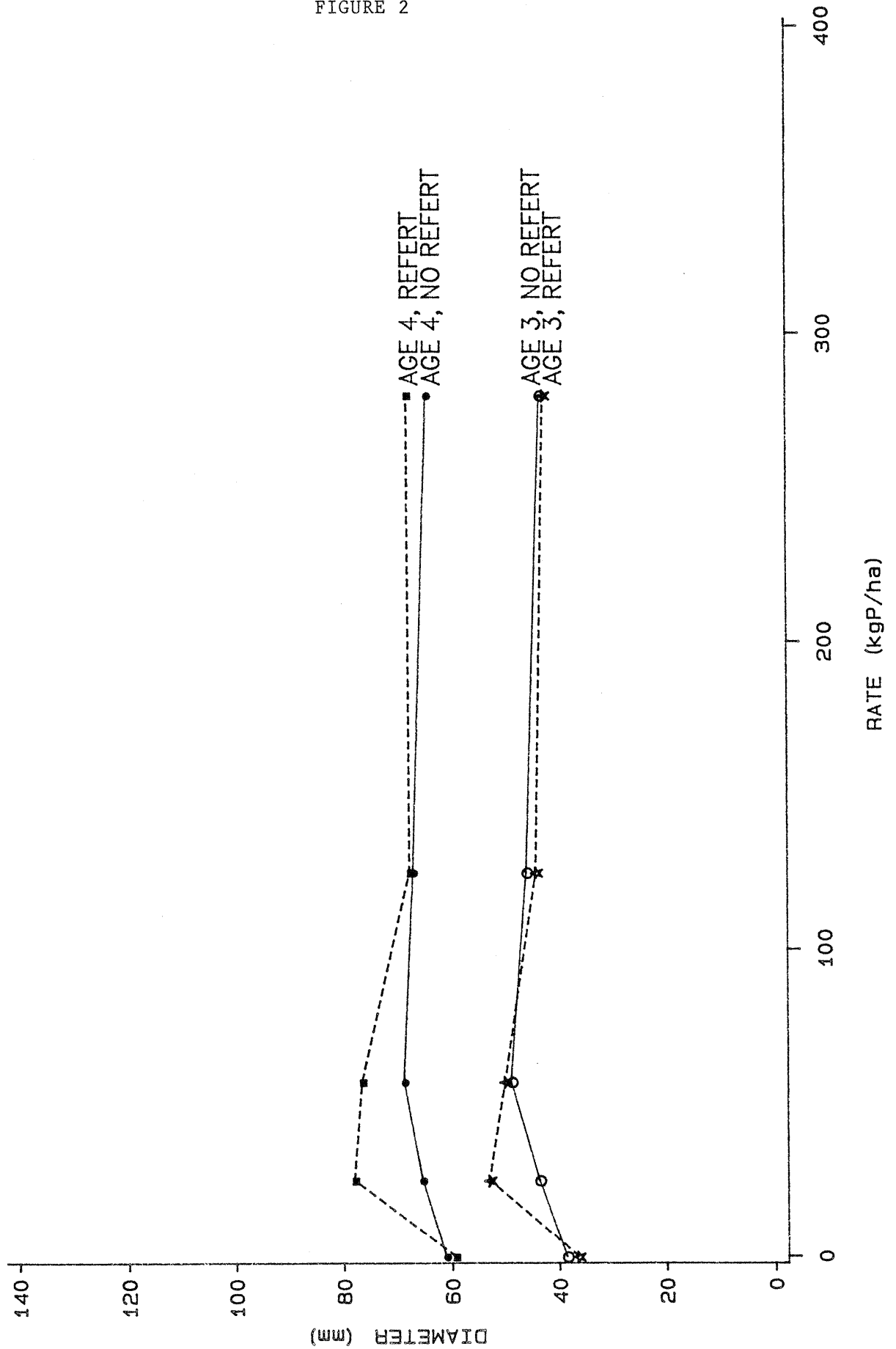


FIGURE 3

THE EFFECT OF FERTILISER TREATMENT ON HEIGHT GROWTH

AK925/2

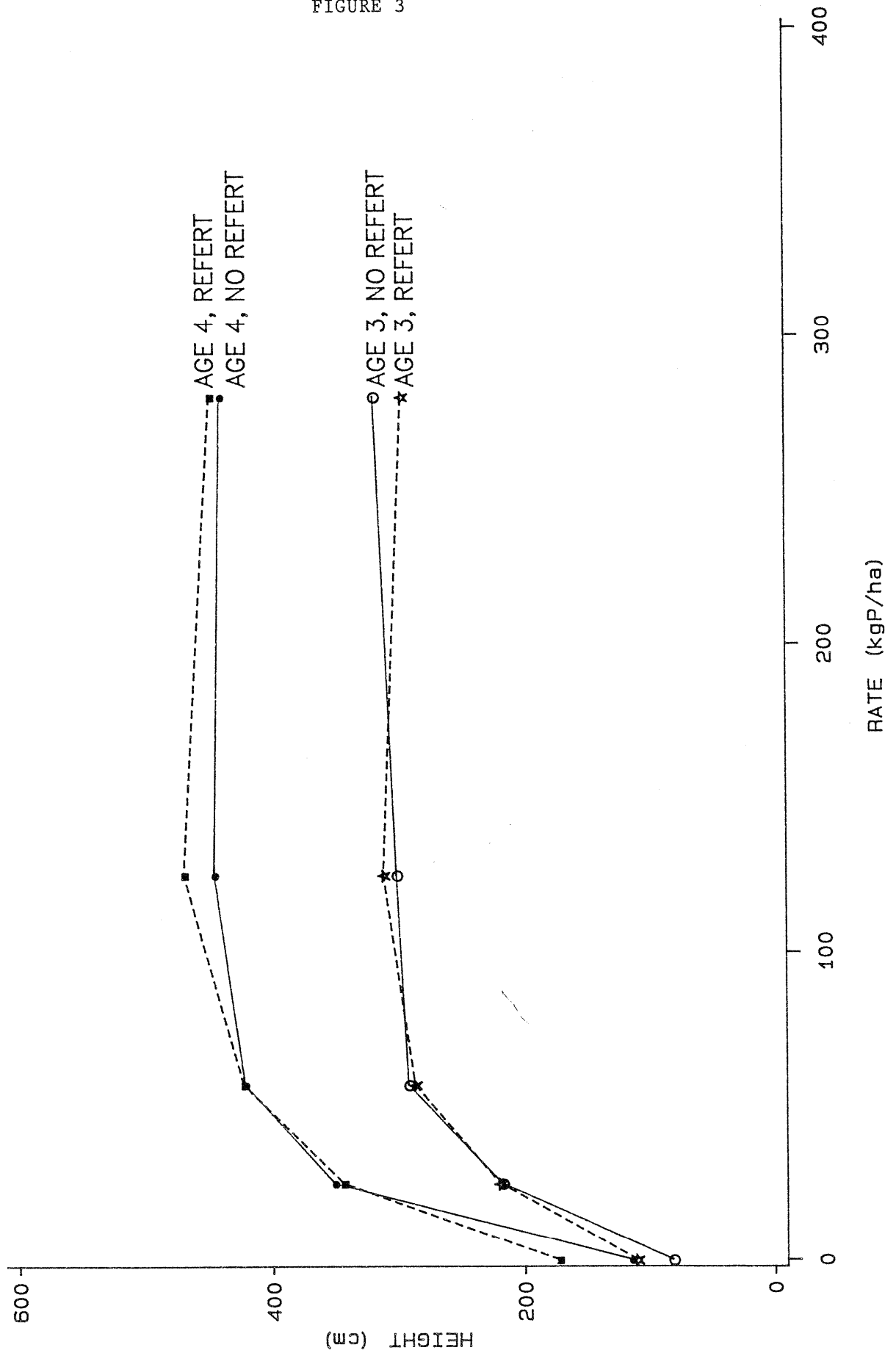
LSD $P=0.05$ AGE4 59.7cm, AGE5 90.5cm

FIGURE 4

THE EFFECT OF FERTILISER TREATMENT ON DIAMETER GROWTH

AK925/2

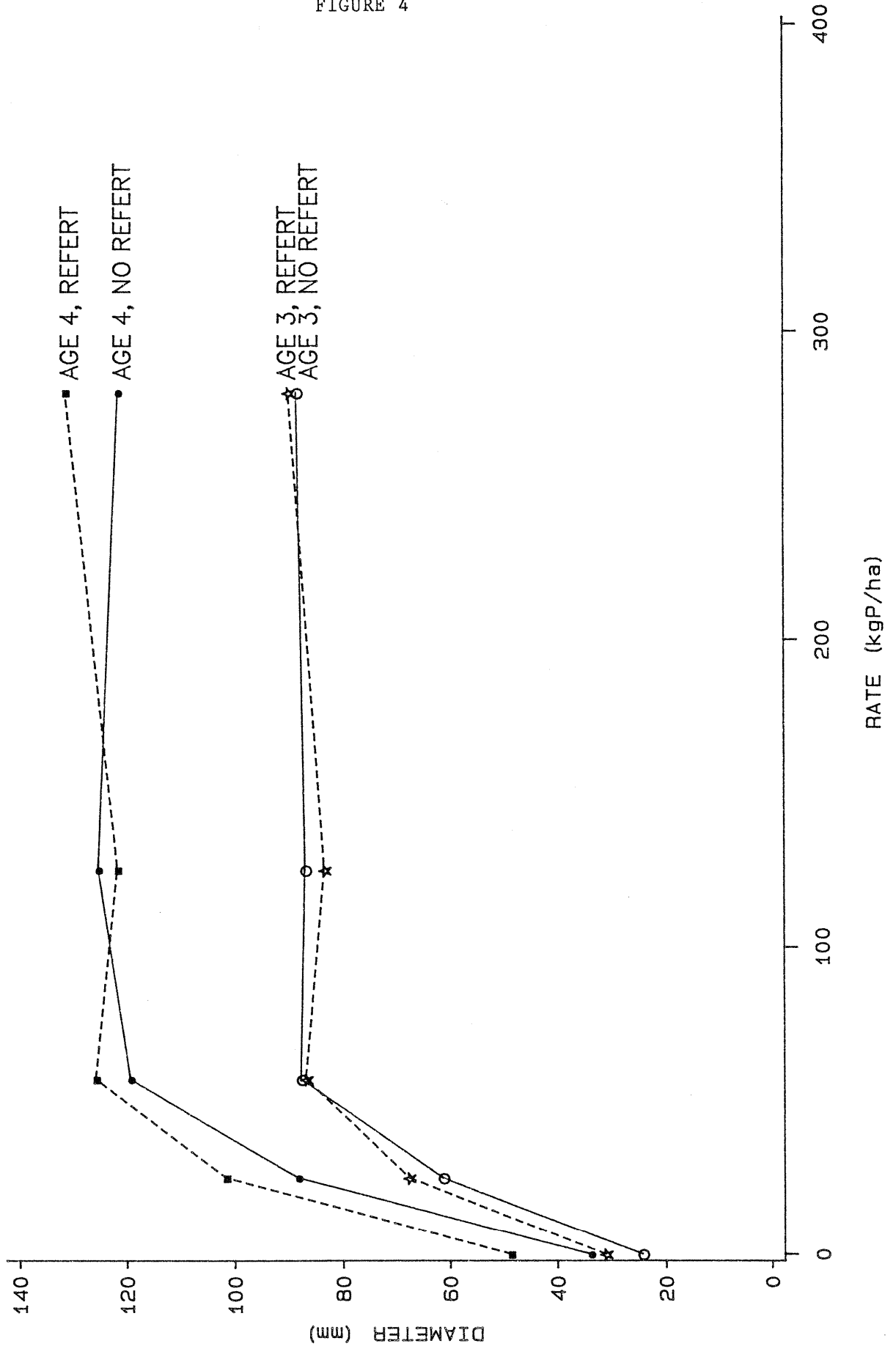
LSD $P=0.05$ AGE4 16.5mm, AGE5 23.2mm

FIGURE 5

THE EFFECT OF FERTILISER TREATMENT ON HEIGHT GROWTH AK925/3

LSD $P=0.05$ AGE4 50.8cm, AGE5 86.6cm

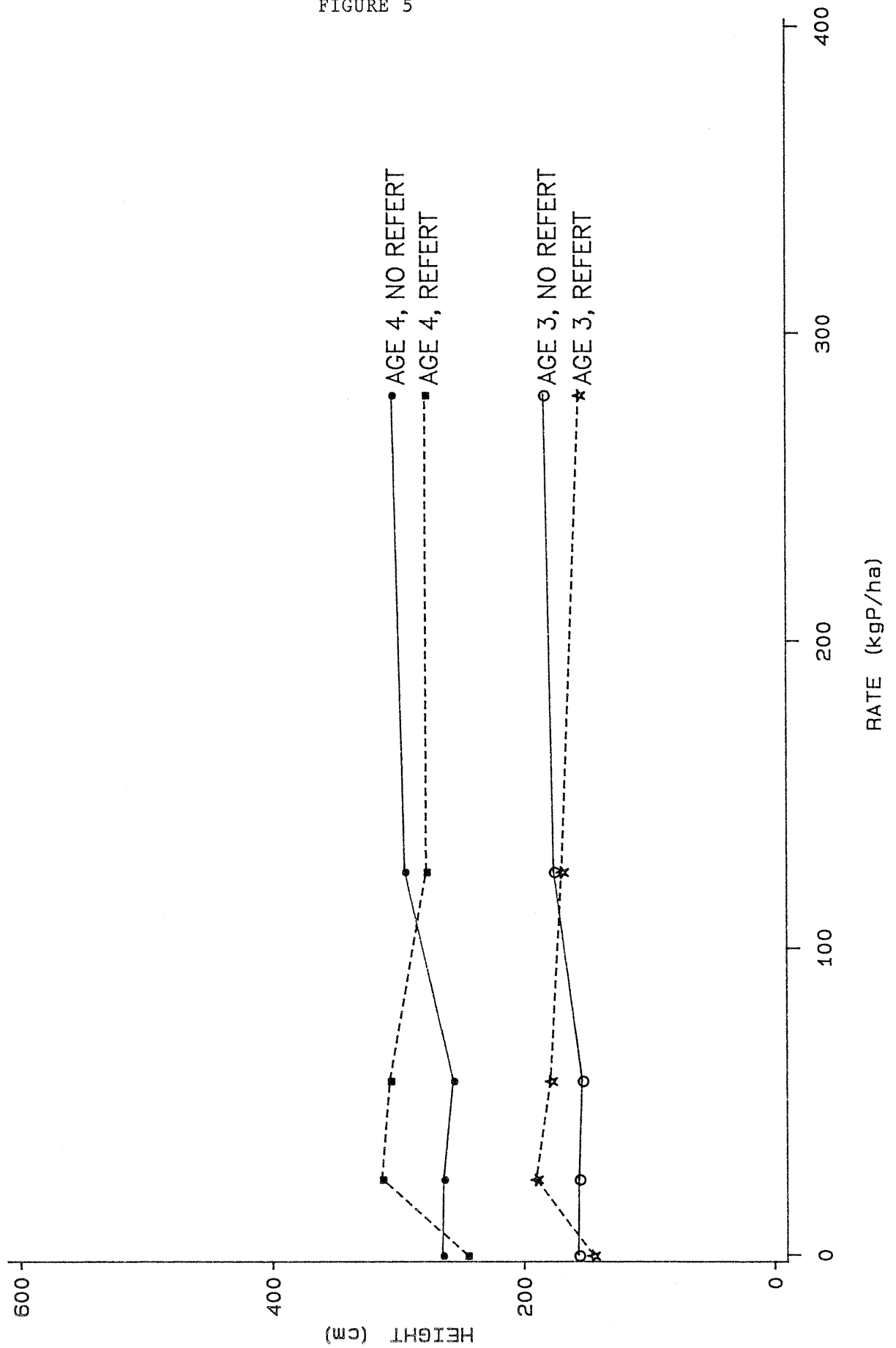


FIGURE 6

THE EFFECT OF FERTILISER TREATMENT ON DIAMETER GROWTH

AK925/3

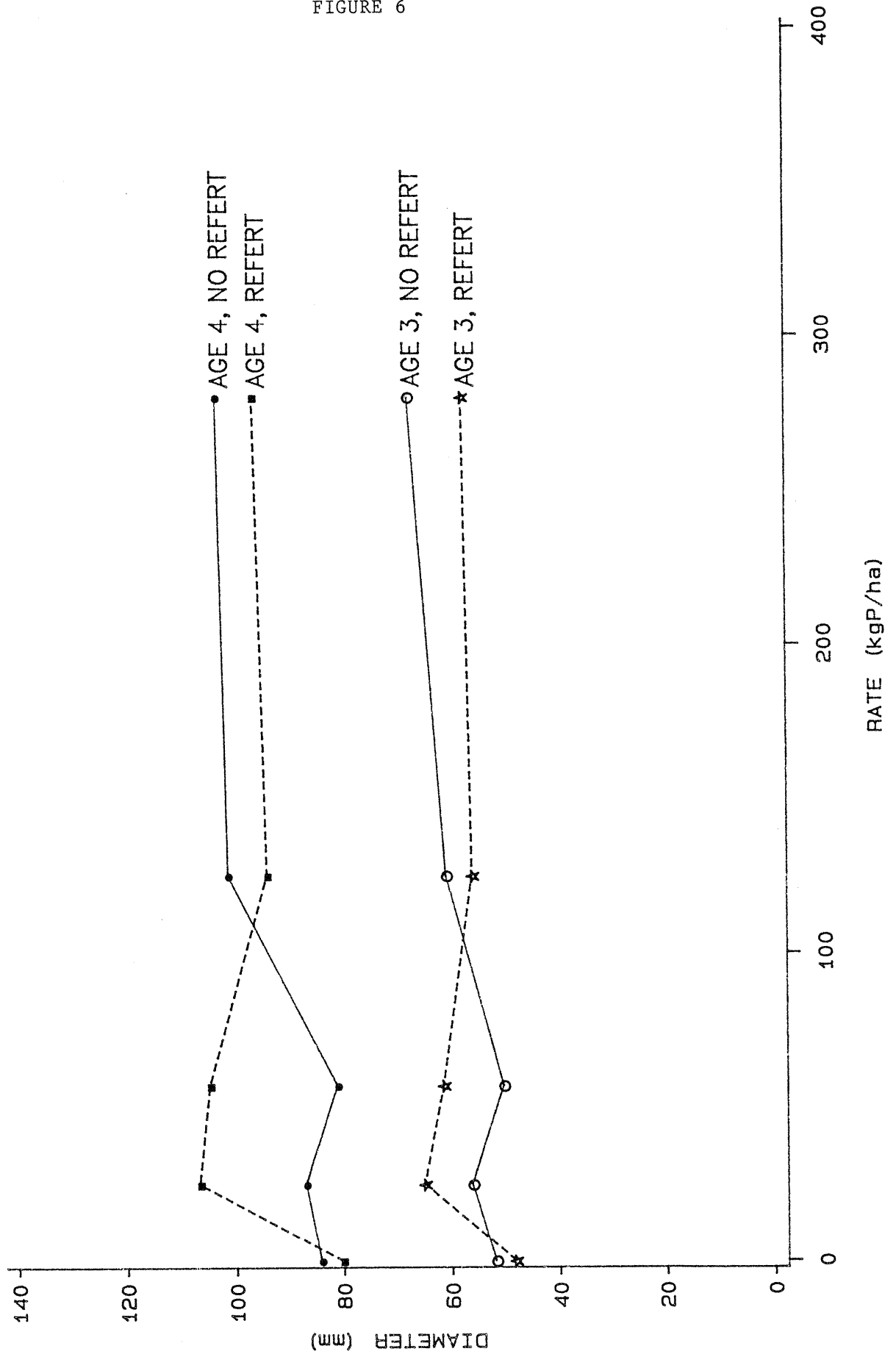
LSD $P=0.05$ AGE4 18.5mm, AGE5 29.0mm

FIGURE 7

THE EFFECT OF FERTILISER TREATMENT ON HEIGHT GROWTH
WN356

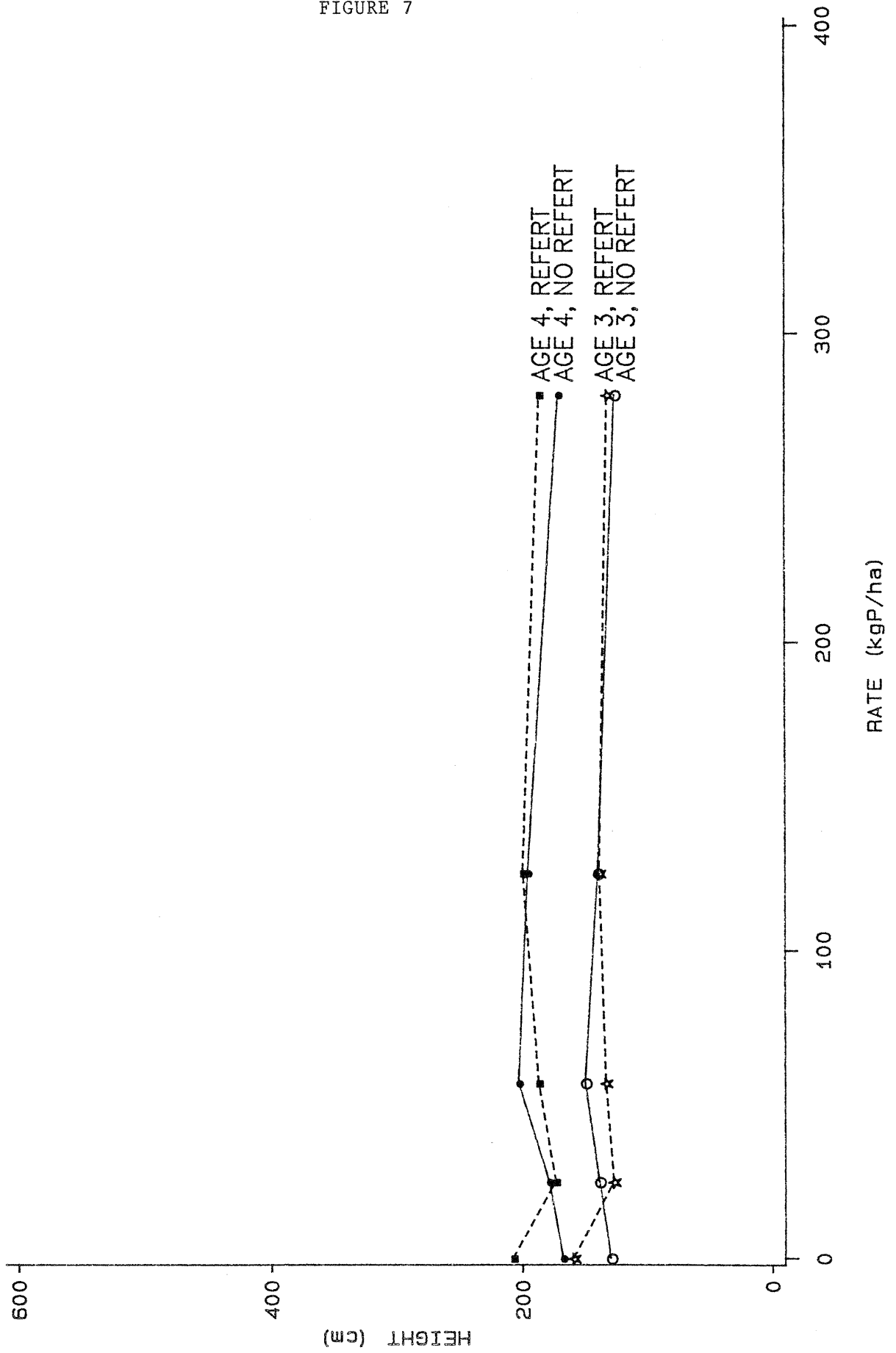


FIGURE 8

THE EFFECT OF FERTILISER TREATMENT ON DIAMETER GROWTH
WN356

