Project No. 1757

AK850/1 AK850/2 AK850/3 AK920

THE USE OF ROCKPHOSPHATE IN THE ESTABLISHMENT AND EARLY GROWTH OF RADIATA PINE

by

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FRI/INDUSTRY RESEARCH COOPERATIVES

EXECUTIVE SUMMARY

This report summarises the age 7 results and should be read alongside National Forest Fertilising Cooperative Report No. 14 issued September 1987.

* On podzolised sands and clays of Northland rock phosphate fertiliser applied at time-of-planting has prevented phosphate from becoming growth limiting.

* On podzolised sands, nitrogen (N) and potassium (K) are limiting growth; where trees were refertilised with N, P and K at age 3, the K deficiency has been overcome.

* On the granular clays (high P fixation) of Coromandel (Tairua) at least 500 kg P/ha is required at time-of-planting to maintain foliar P in excess of 0.11%.

* On the granular clays (high P fixation) of Coromandel (Tairua Forest), P fertilisation can be delayed until age 3.

TRIAL AK 850/1

ESTABLISHED

1980 Te Kao (Carter Holt Harvey) on Te Kopuru Sand (low P fixation).

TREATMENTS

1. Control
2. 145 kg P/ha as GPR
3. 115 kg P/ha as 1:1 mix super:GPR

Refertilised 1983 with NPK at 90:100:100 kg/ha.

RESULTS

1. Growth

Refer to Figures 1 and 2. By age 7 the treatment differences that had existed at age 6 were slightly (but not significantly) increased. The volume productivities are listed below.

	Volume (m^3/ha)		
	Control	GPR	GPR/Super
No refertilisation	45	72	67
Refertilisation	39	88	101

The response to refertilisation at this site for both GPR treatments is likely to be due to improvements in N and K nutrition (see table).

2. Nutrition

The results for foliar N, P and K are summarised below.

Treatment	Refert.	Concentration (%) N	P	K
Control	Yes	1.17	0.13	0.63
	No	1.07	0.08	0.38
GPR	Yes	1.20	0.14	0.68
	No	1.16	0.11	0.37
GPR/Super	Yes	1.22	0.15	0.64
	No	1.18	0.11	0.39

* All treatments are now markedly N deficient.

* P levels are at 0.11% for both GPR and GPR/Super treatments (the ability to sustain foliar P at or above 0.11% where N and K are not limiting is being tested in AK 920).

* K levels are deficient where trees were not refertilised with K at age 3.

TRIAL A 850/2

ESTABLISHED

1980 Maramaku Block (NZ Forest Products) on Hukerenui/Wharakohe clay loam (medium P fixation).

TREATMENTS

1. Control
2. 145 kg P/ha as GPR
3. 115 kg P/ha as 1:1 mix GPR/Super

RESULTS

1. Growth

Refer to Figures 3 and 4. The relative growth differences at 7 were slightly greater compared with age 6. the volume productivities are listed below.

	Volume (m^3/ha)		
	Control	GPR	GPR/Super
No refertilisation	37	128	164
Refertilisation	81	168	174

The reduced growth of radiata pine fertilised with GPR alone appears to be related to nitrogen lack (see NFFC Report 14).

2. Nutrition

The results for foliar N, P and K are summarised below.

Treatment	Refert.	Concentration (%) N	P	K
Control	Yes	1.30	0.10	0.76
	No	1.70	0.07	0.58
GPR	Yes	1.40	0.12	0.90
	No	1.51	0.11	0.76
GPR/Super	Yes	1.41	0.11	0.81
	No	1.34	0.10	0.99

The improved growth in the GPR/Super treatment is reflected in a lower N status (1.3%) compared with the GPR treatment (1.5%). Foliar P had declined to 0.10% in the GPR/Super treatment. Foliar K values appear to be adequate.

AK 850/3

ESTABLISHED

1981 Tairua Forest on Whangamata ash (high P fixation).

TREATMENTS

1. Control
2. GPR (Xmas/Nauru) 100 kg P/ha
3. GPR (Xmas/Nauru) 500 kg P/ha
4. GPR (Sechura) 100 kg P/ha
5. GPR (Sechura) 500 kg P/ha
6. GPR (X/N)/Super 100 kg P/ha
7. GPR (X/N)/Super 500 kg P/ha

Refertilised age 3 with NPK at 90:100:100 kg/ha.

RESULTS

1. Growth

Refer to Figures 5 and 6. There were no differences in tree growth between the GPR treatments, and to the effect of refertilisation at age 3, as listed below for volume productivities.

	Volume (m^3/ha)	
	No refertilisation	Refertilisation
1. Control	72	80
2. GPR (Xmas/Nauru) 100 kg P/ha	64	100
3. GPR (Xmas/Nauru) 500 kg P/ha	92	84
4. GPR (Sechura) 100 kg P/ha	70	82
5. GPR (Sechura) 500 kg P/ha	90	68
6. GPR (X/N)/Super 100 kg P/ha	85	85
7. GPR (X/N)/Super 500 kg P/ha	86	86

2. Nutrition

The results for N and P at age 6 are summarised below.

Treatment	Refert.	Concentration (%) N	P
Control	No	1.36	0.09
	Yes	1.40	0.12
X/N 100	No	1.36	0.09
	Yes	1.37	0.12
X/N 500	No	1.38	0.11
	Yes	1.37	0.12
Sech 100	No	1.30	0.10
	Yes	1.47	0.13
Sech 500	No	1.38	0.13
	Yes	1.39	0.13
GPR/Super 100	No	1.36	0.10
	Yes	1.39	0.13
GPR/Super 500	No	1.40	0.12
	Yes	1.33	0.13

Control trees are now markedly P deficient at age 6 (0.09% P). None of the 100 kg P/ha treatments could maintain foliar P above 0.11% (foliar P concentrations were slightly higher with the reactive rock, and with the GPR/Super mixes).

The 500 kg P/ha treatments were capable of maintaining foliar P in excess of 0.11%, the X/N GPR sustained foliar P at 0.11%, with Sechura GPR at 0.13%.

3. Discussion

The lack of growth difference between treatments, that is, controls now deficient in P at 0.09%, and fertilised trees in excess of 0.11%, is, in all likelihood, a reflection of the close stocking this experiment has been maintained at (for comparability with AK 850/1, and AK 850/2).

TRIAL AK 920 - Comparison of different types of GPR

ESTABLISHED

Te Kao on Ohia Sand, Carter Holt Industries.

TREATMENTS

1. Control
2. Christmas/Nauru at 100 kg P/ha (bedded area only)
3. Sechura at 100 kg P/ha (bedded area only)
4. X/N/Super at 100 kg P/ha (bedded area only)
5. Arad at 100 kg P/ha (bedded area only)

RESULTS

1. Growth

The growth results are presented in Figures 7 and 8. By age 5, control trees had produced 10 m^3/ha. Fertilised trees grew from 16-19 m^3/ha. All GPR types were comparable.

2. Nutrition

Treatment	N	P	K	Ca	Mg
Control	1.2	.08	.29	.08	.12
Christmas/Nauru	1.0	.10	.19	.13	.14
Sechura	1.1	.11	.24	.12	.16
X/N/Super	1.1	.10	.22	.14	.16
Arad	1.1	.11	.30	.16	.18

Trees treated with Christmas/Nauru phosphate rock, and with Christmas/Nauru/ Superphosphate exhibited foliar P below the threshold value of 0.11%. In contrast the Sechura and Arad treatments maintained foliar P at 0.11%. Foliar K levels were extremely low (equal or less than 0.3%).

This experiment was refertilised with N and K and 100 kg element/ha during late 1987 in order to place further stress on the phosphate rock treatments.

FIGURE 1

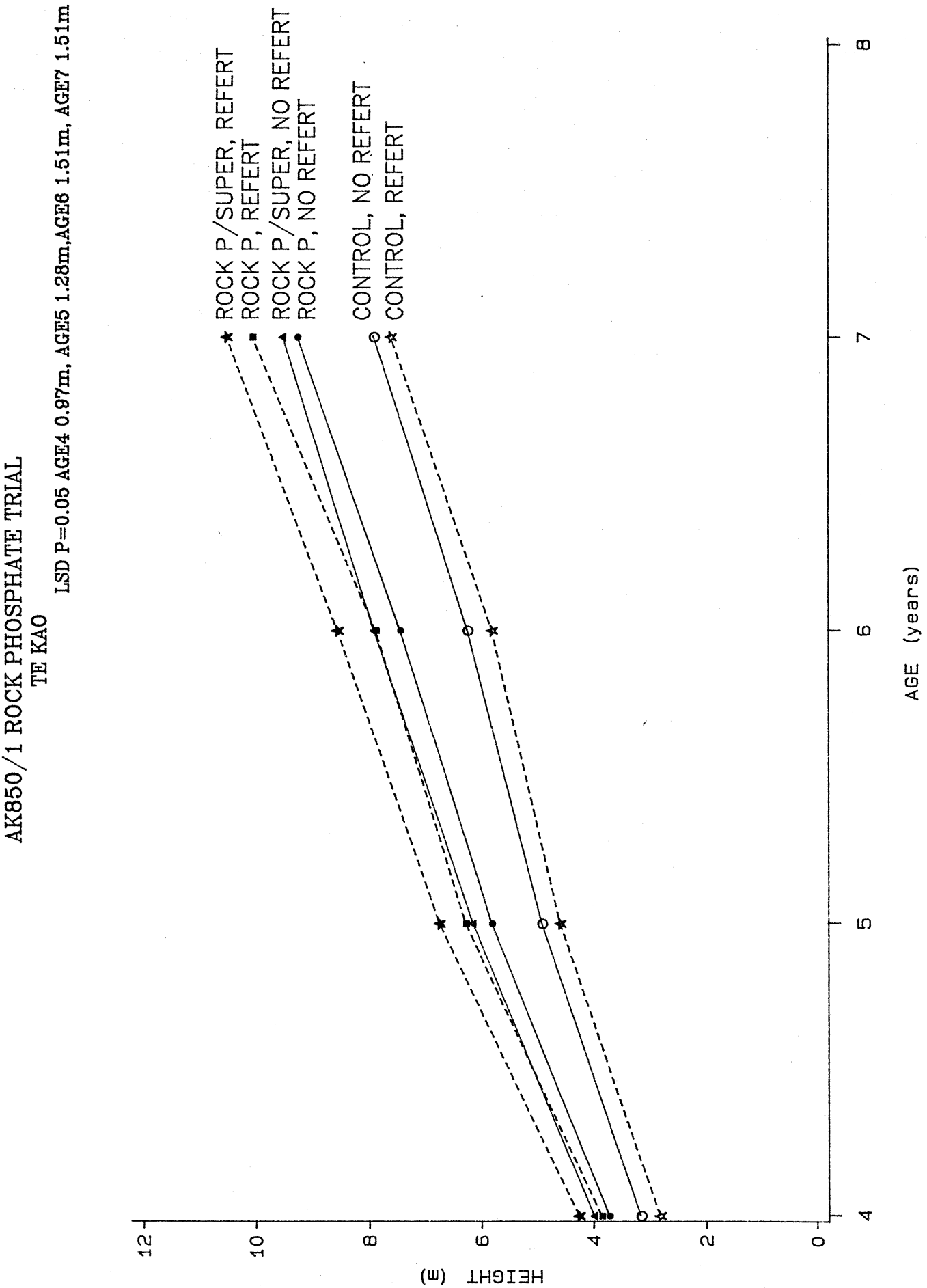

AK850/1 ROCK PHOSPHATE TRIAL
TE KAO
LSD P=0.05 AGE4 0.97m, AGE5 1.28m,AGE6 1.51m, AGE7 1.51m
ROCK P/SUPER, REFERT
ROCK P, REFERT
ROCK P/SUPER, NO REFERT
ROCK P, NO REFERT
CONTROL, NO REFERT
CONTROL, REFERT
HEIGHT (m)
AGE (years)
0
2
4
6
8
10
12
4
5
6
7
8

FIGURE 2

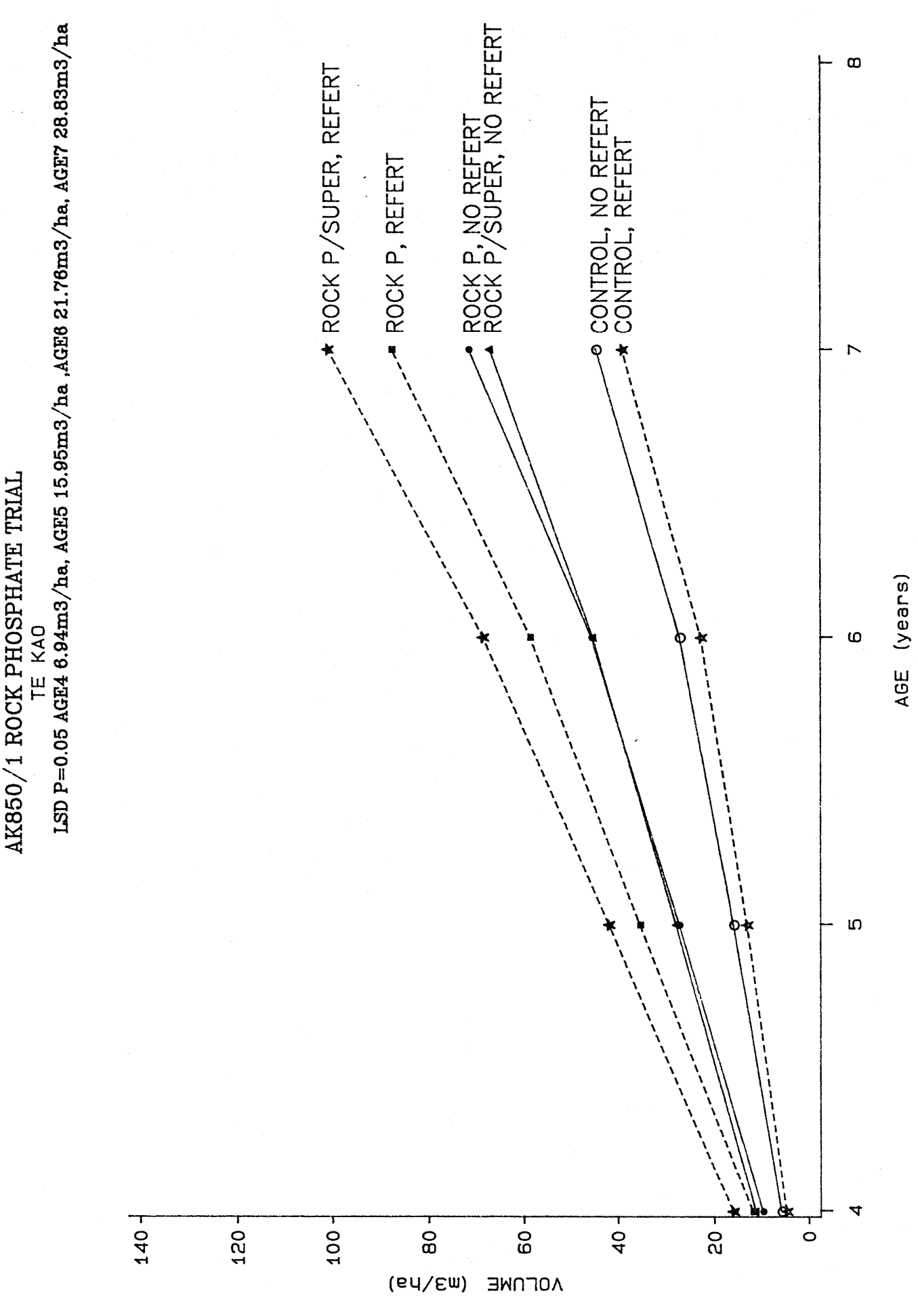

AK850/1 ROCK PHOSPHATE TRIAL
TE KAO
LSD P=0.05 AGE4 6.94m3/ha, AGE5 15.95m3/ha ,AGE6 21.76m3/ha, AGE7 28.83m3/ha
ROCK P/SUPER, REFERT
ROCK P, REFERT
ROCK P, NO REFERT
ROCK P/SUPER, NO REFERT
CONTROL, NO REFERT
CONTROL, REFERT
VOLUME (m3/ha)
AGE (years)
0
20
40
60
80
100
120
140
4
5
6
7
8

FIGURE 3

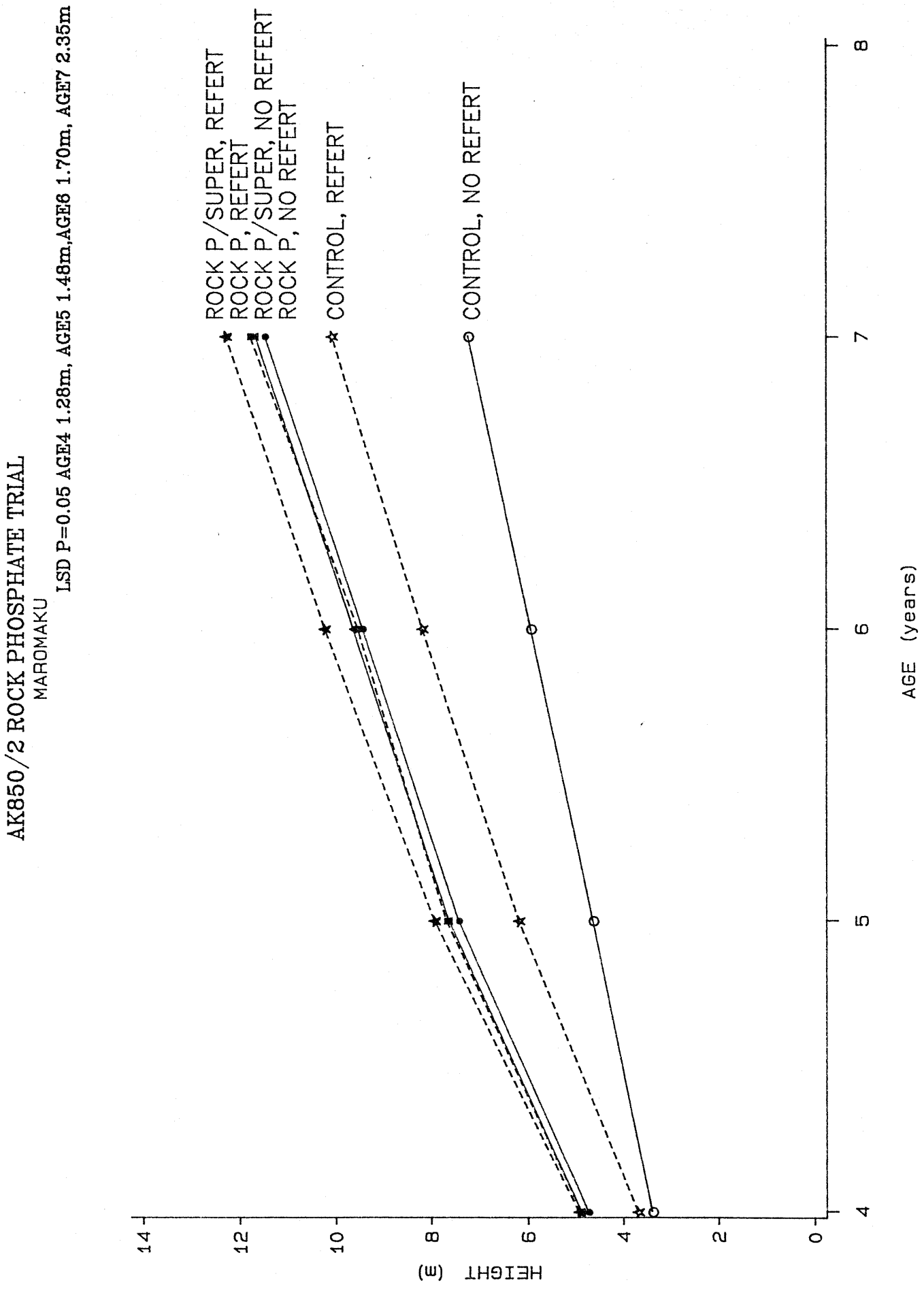

AK850/2 ROCK PHOSPHATE TRIAL
MAROMAKU
LSD P=0.05 AGE4 1.28m, AGE5 1.48m,AGE6 1.70m, AGE7 2.35m
ROCK P/SUPER, REFERT
ROCK P, REFERT
ROCK P/SUPER, NO REFERT
ROCK P, NO REFERT
CONTROL, REFERT
CONTROL, NO REFERT
HEIGHT (m)
0
2
4
6
8
10
12
14
AGE (years)
4
5
6
7
8

FIGURE 4

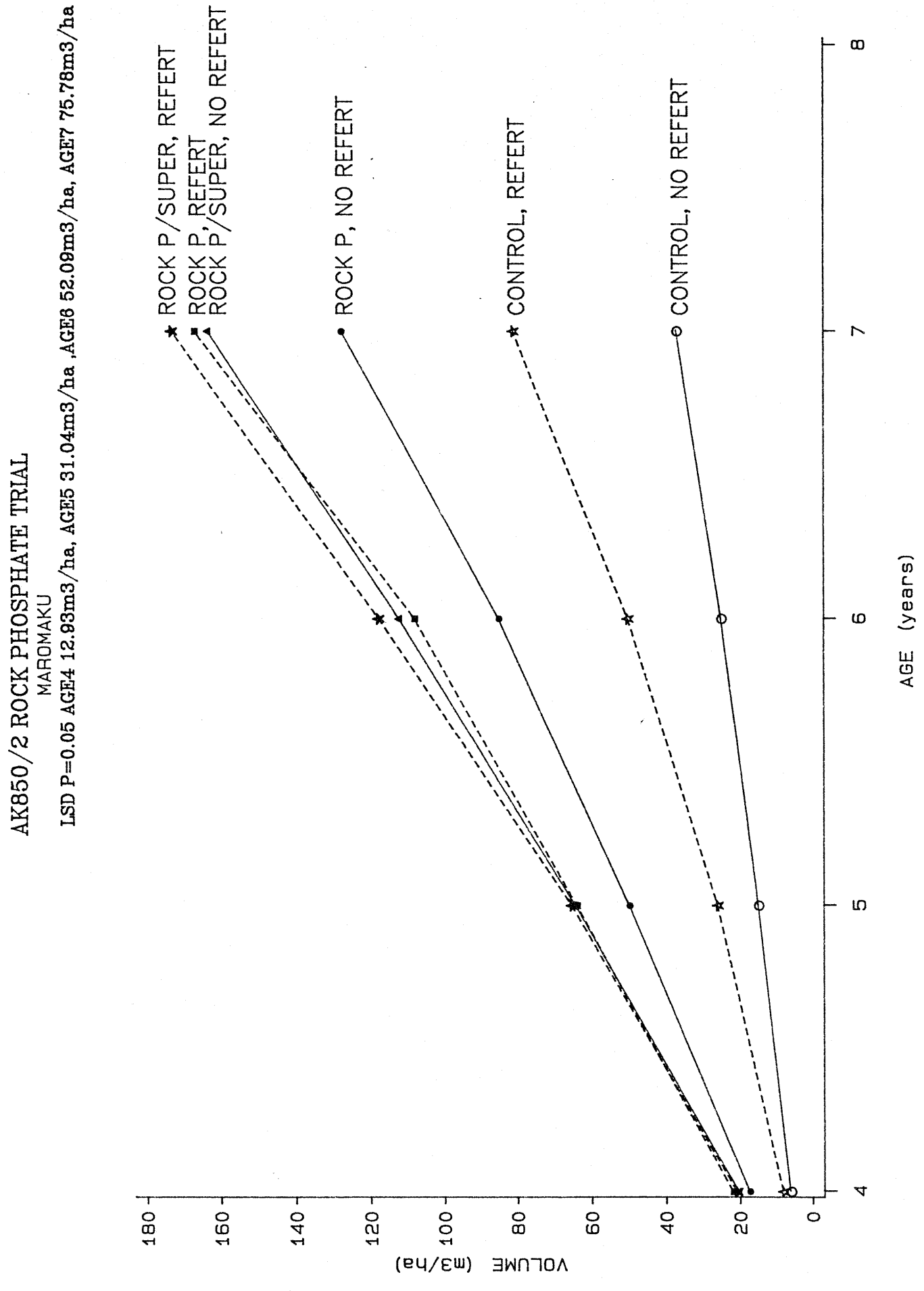

AK850/2 ROCK PHOSPHATE TRIAL
MAROMAKU
LSD P=0.05 AGE4 12.93m3/ha, AGE5 31.04m3/ha ,AGE6 52.09m3/ha, AGE7 75.78m3/ha
ROCK P/SUPER, REFERT
ROCK P, REFERT
ROCK P/SUPER, NO REFERT
ROCK P, NO REFERT
CONTROL, REFERT
CONTROL, NO REFERT
VOLUME (m3/ha)
AGE (years)
0
20
40
60
80
100
120
140
160
180
4
5
6
7
8

FIGURE 5

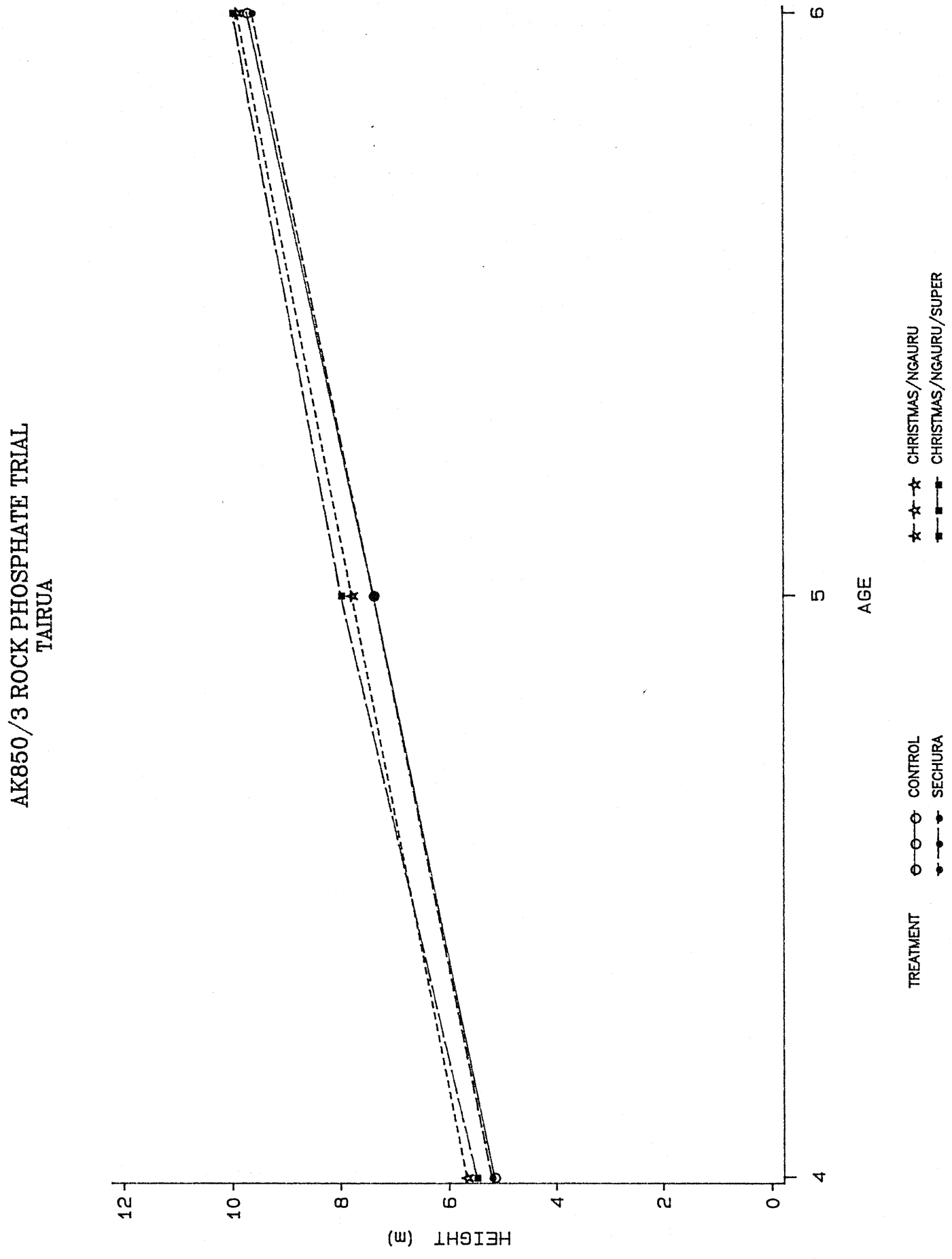

AK850/3 ROCK PHOSPHATE TRIAL
TAIRUA
HEIGHT (m)
0
2
4
6
8
10
12
4
5
6
AGE
TREATMENT
CONTROL
SECHURA
CHRISTMAS/NGAURU
CHRISTMAS/NGAURU/SUPER

FIGURE 6

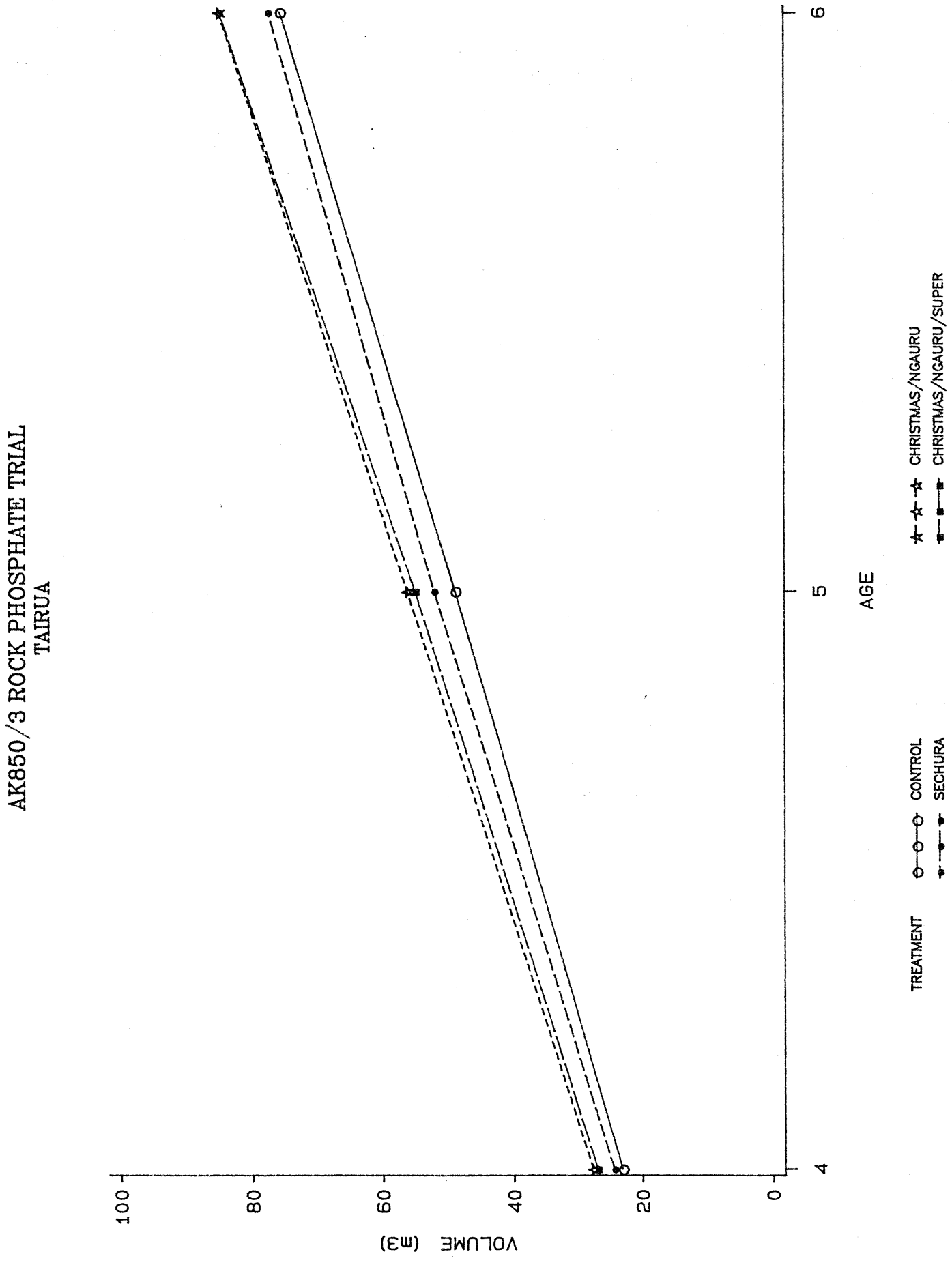

AK850/3 ROCK PHOSPHATE TRIAL
TAIRUA
VOLUME (m3)
0
20
40
60
80
100
4
5
6
AGE
TREATMENT
CONTROL
SECHURA
CHRISTMAS/NGAURU
CHRISTMAS/NGAURU/SUPER

FIGURE 7

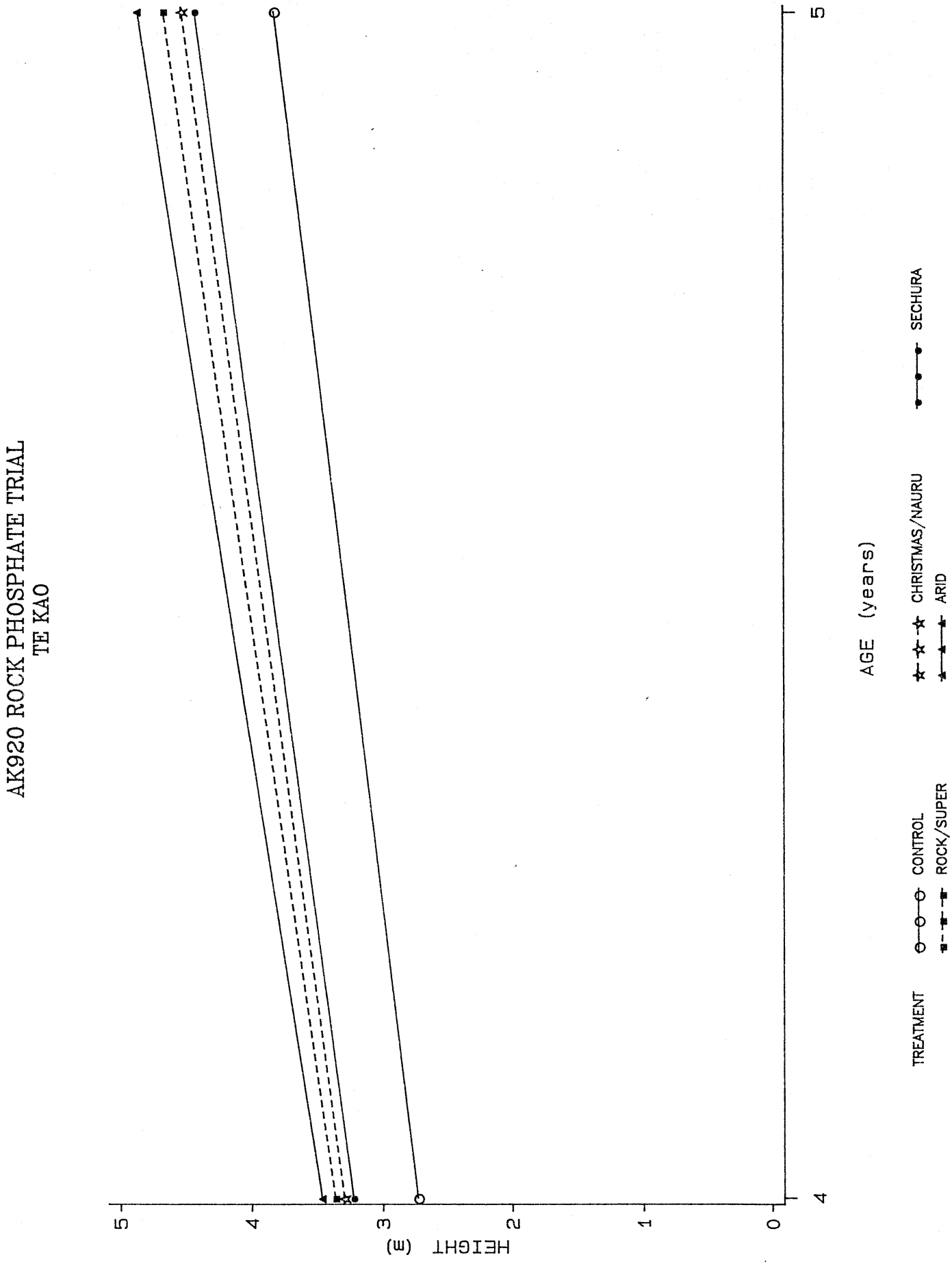
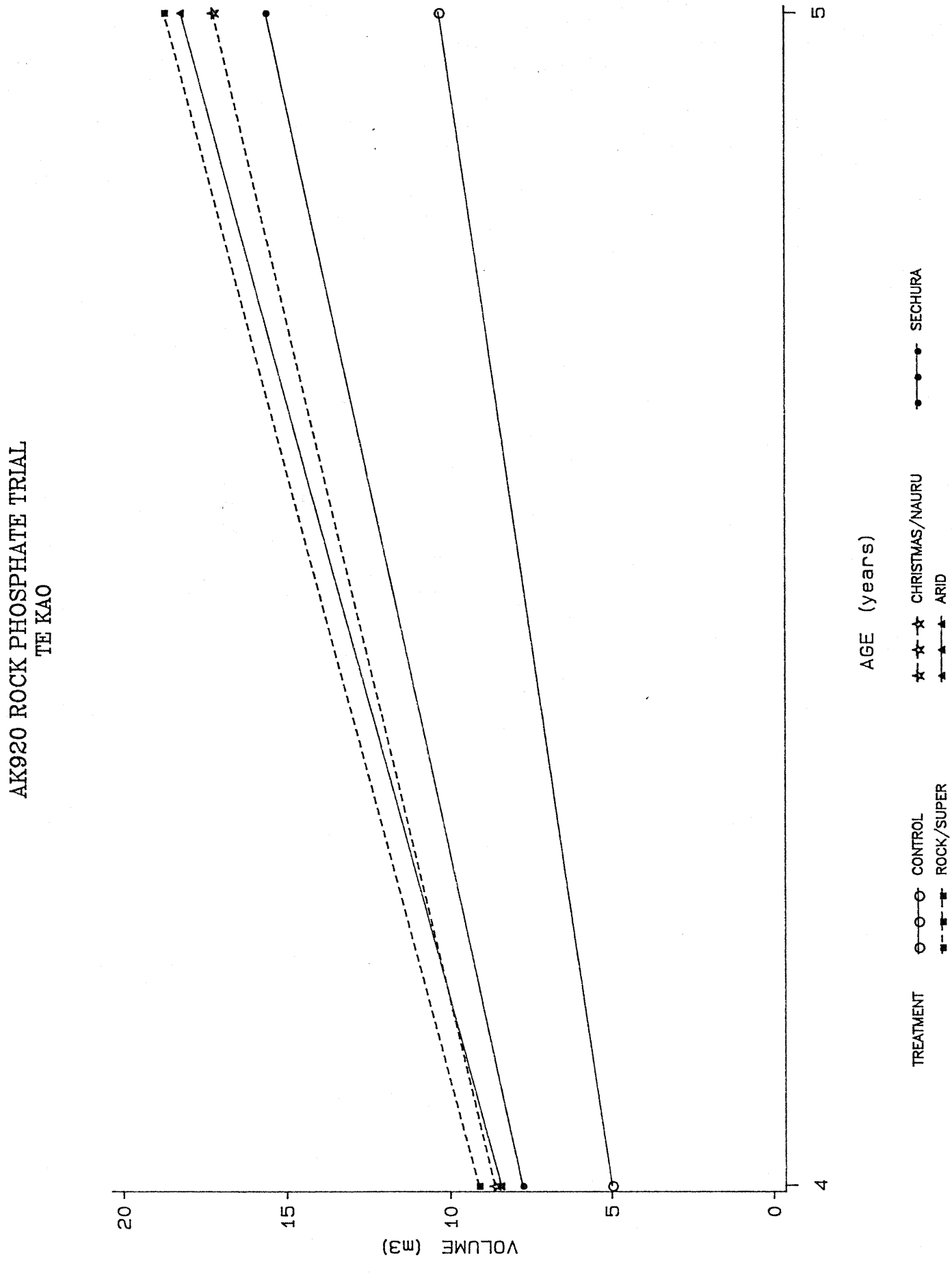

AK920 ROCK PHOSPHATE TRIAL
TE KAO
HEIGHT (m)
0
1
2
3
4
5
4
5
AGE (years)
TREATMENT
CONTROL
ROCK/SUPER
CHRISTMAS/NAURU
ARID
SECHURA

FIGURE 8


AK920 ROCK PHOSPHATE TRIAL
TE KAO
VOLUME (m3)
20
15
10
5
0
4
5
AGE (years)
TREATMENT
CONTROL
ROCK/SUPER
CHRISTMAS/NAURU
ARID
SECHURA