PINUS TORREYANA AT ROTORUA.

By J. F. LYSAGHT.

1. History of the Tree.

Pinus torreyana or Soledad pine is described by Dallimore and Jackson as a "small tree 30 to 40 feet high with short, stout branches, or, in exposed places, a low tree, bush, or semi-prostrate shrub." Sargent describes it as a "tree usually 30 to 40 feet high with a short trunk about 1 foot in diameter or occasionally 50 to 60 feet tall with a straight, slightly tapering stem 2½ feet in diameter." Its natural distribution is very limited, being confined to small areas near the mouth of the Soledad River, just north from San Diego, and on the island of Sata Rosa, California. Like Monterey pine (*P. radiata*) this species has shown markedly better growth in New Zealand than in its natural habitat, but has not been much planted on account of the limited seed supply, and the difficulty of handling the young trees.

2. Planting in Rotorua.

From records it appears that when the Public Gardens were originally laid out in Rotorua, a small number of these trees were included. In 1904 when these trees had grown to some considerable size, it was found necessary to clear-fell them and the then Nurseryman in Charge (Mr. Goudie) collected some of the seed and raised a few trees in the Rotorua Nursery. In 1906, 250 of these trees were planted in a small plot, 0.375 of an acre, at a spacing of 8 ft. by 8 ft., and a few others were planted as arboretum specimens. At the time it was reported that the young seedlings were most difficult to plant out, as no amount of wrenching would induce a fibrous root growth, and all the trees had to be transplanted with a ball of earth. The only attention paid to this plot was a high pruning of all the trees up to 16 ft. and a small amount of under-planting with *P. strobus* in one corner and odd trees of *P. lambertiana* and *Tsuga heterophylla*. In 1944 the whole plot was heavily thinned.

3. Measurements of the Plot.

Of the 250 trees originally planted in 1906, 227 were accounted for at the first measurement in 1935. The plot was again measured in 1940 and in 1944 before and after thinning with the following results

Year	No. Trees	Min. D.B.H. inches	Max. D.B.H. inches	Av. D.B.H. inches	Basal Area : sq. ft.
1935	227	6	26	11.45	162.3
1940	175	7	29	13.0	160.4
1944	152	7	30	14.5	175.1
1944	66	9	30	15.75	89.3

Apparently considerable deaths through suppression occured after 1935 and to obtain better growth, thinning should have been undertaken at about that time. Total heights were taken with the Abney level in 1944 as follows :—

Tree No.	D.B.H. inches	Total Height feet.
Q 11	19.1	126
P 4	21.4	125
E 3	16.7	112
B 2	14.1	98
A 5	14.2	93

4. **Volumes of Timber on Plot.**

Merchantable volumes have been calculated inside bark to a 6 in. top and were as follows :—

Year	Volume Per Plot cubic feet	Volume per Acre cubic feet
1935	4,247	11,325
1940	4,710	12,560
1944	5,636	15,030
1944	3,021	8,055

The difference between the volume before and after thinning is 2,615 cu. ft. and delivery dockets show that 2,147 cu. ft. or 82% of this was received by the mill as saw logs. The mean annual increment at 38 years is 395 cu. ft. Both volume per acre and M.A.I. are exaggerated because two sides of the plot are marginal, and carry trees far larger than those in the interior.

5. **Description of the Trees.**

The trees are generally of small diameter, showing a regular growth on average trees of a little less than half an inch a year. They are tall with little taper, branches are light and whorls about 4 ft. apart. Foliage is scanty being confined to clusters of long glaucous needles at the tips of the topmost branches. For its age and size, this tree appears to carry many more stems per acre than other pines. Mature trees produce on the higher branches only very occasional large cones which appear to open and shed their seed during the autumn and winter and then persist for some time finally to fall, leaving the stalk and basal scales on the tree. Seeds are large and can be picked up from the ground during the autumn and winter, and are much sought after by native children for the edible kernel. Previous to thinning no regeneration had been observed, but now small seedlings up to 6 ins. in height are occasionally coming up inside the stand. The timber was used with that of Monterey pine for

boxing and creating ; it appeared to have a more even rate of growth, a larger proportion of summer wood and to be freer from knots, but was more brittle than Monterey pine.

6. Growth of Trees.

Maximum diameter growth at breast height is 30 ins. in 38 years or 0.79 ins. per annum, and average diameter growth is 15.75 ins. in 38 years or 0.415 ins. per annum as compared with 0.58 ins. for Monterey pine under similar circumstances. Average height growth for this Soledad pine is 111 ft. in 38 years or 2.9 ft. per year which is considerably less than the 3.9 ft. for Monterey pine over a similar period. Height and diameter growth appear to be still proceeding vigorously. The volume growth recorded, 15,000 cu. ft. per acre in 38 years or 395 cu. ft. per annum, is exaggerated, owing to the fact that two sides of the plot were marginal and so supported large trees ; nevertheless, with its light top and denser stocking, it would under present conditions not be far behind the average of 350 cu. ft. per acre for Monterey pine.

7. Local Conditions.

The plot at Rotorua is situated 30 miles from the sea at an elevation of 950 ft. on level ground with a northerly (i.e. sunwards) aspect. The soil is about 6 ins. of dark loam over a loose gravelly pumice into which tree roots normally penetrate to a depth of more than six feet. Annual rainfall of 50 to 60 inches is well distributed. Mean temperatures range from 23° to 88°F. with 40 to 50 frosts a year. There are no falls of snow and no strong winds.

8. Summary.

A small plot of *P. torreyana* (Soledad pine) trees was established in Rotorua in 1906. In 1944 these trees had an average D.B.H. of 15.75 ins. and height of 111 ft. with an estimated merchantable volume per acre of 15,000 cu. ft. This compares favourably with Monterey pine, our fastest growing species, but owing to poor seeding and difficulties in transplanting, it is not likely that this species will be extensively used in afforestation.

P. TORREYANA.—Summary of Plot Measurements.

	1935		1940		1944			
					Before Thinning		After Thinning	
D.B.H Inches	No. Trees	Basal Area	No. Trees	Basal Area	No. Trees	Basal Area	No. Trees	Basal Area
4	6	0.5						
5	6	0.8						
6	11	2.2						
7	27	7.2	15	4.0	1	0.3		
8	20	7.0	13	4.5	3	1.0		
9	30	13.3	17	7.5	10	4.4	3	1.3
10	29	15.8	19	10.4	14	7.6	1	0.5
11	28	18.5	24	15.8	17	11.2	6	4.0
12	20	15.7	16	12.6	22	17.3	5	3.9
13	13	12.0	22	20.3	14	12.9	9	8.3
14	2	2.1	12	12.8	20	21.4	12	12.8
15	4	4.9	8	9.8	13	16.0	9	11.0
16	7	9.8	5	7.0	8	11.2	5	7.0
17	1	1.6	3	4.7	3	4.7	3	4.7
18	7	12.4	3	5.3	5	8.8	2	3.5
19	4	7.9	3	5.9	3	5.9	1	2.0
20	3	6.5	4	8.7	3	6.5		
21	3	7.2	5	12.0	7	16.8	3	7.2
22	5	13.2	2	5.3	2	5.3	2	5.3
23			1	2.9	2	5.8	1	2.9
24			2	6.3	3	9.4	2	6.3
25								
26	1	3.7			1	3.7	1	3.7
27								
28								
29			1	4.6				
30					1	4.9	1	4.9
Total	227	162.3	175	160.4	152	175.1	66	89.3
Mean D.B.H.		11.45		13.0		14.5		15.75
Area 0.375 acres								
Trees per acre		609		467		405		176
B.A. per acre		432.8		427.7		466.9		138.1