

EXPERIMENTS WITH LIMES (*CITRUS MEDICA* L. VAR. *ACIDA*) IN THE NORTH CENTRAL PROVINCE.

H. A. DEUTROM,

MANAGER, EXPERIMENT STATION, ANURADHAPURA.

THE following records of experimental cultivation of limes at the Experiment Station, Anuradhapura, are of interest and may stimulate the cultivation of this useful crop. That a certain amount of interest is being aroused is proved by the fact that orders for plants and seed are received daily at the Experiment Station.

The juice of the lime is employed for the manufacture of cooling drinks, especially lime juice cordial, and is also used for flavouring soups, curries and fish. It imparts a pleasant acid taste and agreeable flavour. The fruit is pickled and is also largely used. Concentrated lime juice forms one of the principal sources of commercial citric acid. Essential oil of limes and distilled oil are of value in perfumery.

LAND AND RAINFALL.

Lime trees are surface-feeders and develop best and yield the heaviest crops in well-sheltered flat or gently-undulating land situated from sea level up to 2,500 feet elevation and possessing a rainfall varying from 60 to 150 inches per annum. The lime, however, can be successfully grown under other conditions provided there is sufficient rainfall and not too prolonged a dry season. Situations exposed to strong winds are not recommended.

NURSERIES.

A good site should be selected for the seed bed, an aspect which catches the morning sun being best. It should, moreover, be high and dry during wet weather. The soil should be worked up into a fine tilth and laid out in beds 3 feet wide and of any convenient length. To prepare seeds for sowing, the fruit should be chosen from heavy-yielding trees, and the seeds should be washed carefully to remove the adhering pulp and juice. The seeds should then be wiped dry and spread out under shade to dry thoroughly. They should be sown in drills 9 inches apart in the rows with an interval of 3 inches between the seeds at a depth of 1 inch below the surface; the finger or a small stick may be used for making the holes. After sowing, the seed-beds should be kept free from weeds and should be watered every other day in dry

weather. An excessive degree of moisture must be avoided. The seeds will germinate in three or four weeks and the seedlings will be ready for transplanting in nine to ten months from date of sowing of seed.

PREPARATION OF THE FIELD.

The field should be well ploughed and cross-ploughed to a depth of 8 to 9 inches after all stumps and roots have been thoroughly cleared. The clods turned out by the plough should be broken and a fine deep tilth should be prepared.

PLANTING DISTANCES.

The distances at which limes should be grown vary according to the position and texture of the land. Observations of well-developed trees at the Experiment Station show that a spacing of 15 by 15 feet is to be advocated. On poor soils and on steep hill-sides closer distances may be adopted. Holes should be at least 1 foot wide and 1½ feet deep. They should be dug about a month before planting and left exposed. Before planting is done, each hole should be filled with good surface soil and a basketful of well-decomposed farmyard manure thoroughly mixed together and pressed down in the hole.

TRANSPLANTING.

Great care is necessary in taking seedlings from the nursery beds. At the time of uprooting the seedlings the nursery beds should be thoroughly saturated with water as a wet condition of the soil helps the roots to carry as much earth as possible and also allows easy removal of the seedlings with the least injury to their roots. If practicable, showery weather should be chosen for transplanting. The plants should be taken up with all their roots for which purpose a fork is most useful. In use the fork should be pressed vertically into the soil to its maximum depth and then pressed over on one side.

PLANTING-OUT.

The commencement of the north-east monsoon is the best time for planting. It should be done preferably in the evening but a cloudy day can be utilised for the operation. An opening should be made with an alavangu or a wooden peg in the centre of the hole sufficiently deep and broad to admit the plants with their roots extended at full length and in a natural position, and care should be taken to see that the nursery level of the plant is maintained. The soil should then be tightly pressed round the plant with the hands and feet.

AFTER-CULTIVATION.

The lime is an exceedingly hardy plant and needs no protection from the sun at any stage of its growth. After the plants are well established the land should be kept clear of weeds and the

surface constantly stirred to minimise the loss of soil water by evaporation. Mulching by surface-cultivation should therefore be regularly carried on. Manioc, maize, sorghum or chillies may be sown between the rows of lime plants as catch crops. On poor lands a leguminous crop such as green gram or ground-nuts may be sown. Mature limes are not usually clean-weeded. Circles round the plants are kept clean, while the remainder of the field is occasionally disc-harrowed. Under favourable conditions the lime may commence to give a few fruits in the third year after planting, but eight to ten years is the time necessary to bring a lime plantation into full bearing.

CULTIVATION AND FRUITING AT THE EXPERIMENT STATION, ANURADHAPURA.

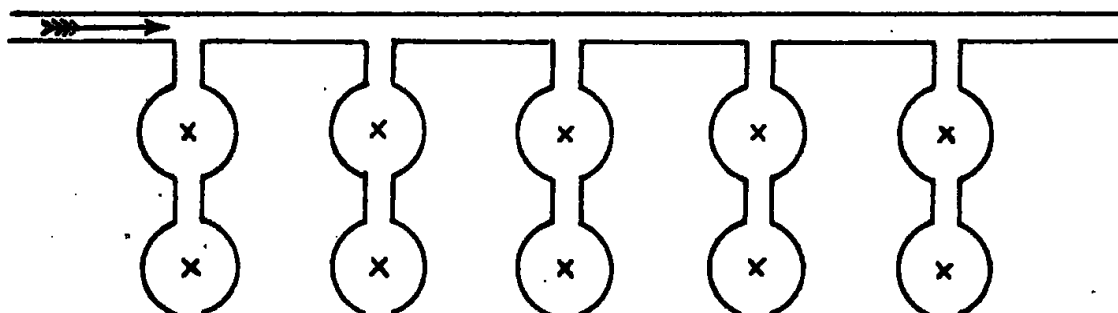
An area of six acres was cleared of jungle in 1918 at a cost of Rs. 35 per acre and planted with limes in the same year. One-year old plants raised from seed of old trees in the Anuradhapura district and of plants raised in Peradeniya from seed received from British Guiana were planted in rows 15 by 15 feet, giving 193 plants to the acre. Castor was sown as a catch crop in 1919 and dhall and green gram in 1920. In 1921 the plants were forked round in rings and mulched with jungle stuff. The dhall planted in 1920 was uprooted and the land was clean-weeded.

The first six rows of the trees along the main road to Jaffna were manured with farmyard manure in trenches cut round the plants in the year 1923. In the same year sunn hemp was sown round the young plants in basins. Regular cultivation by ploughing between the rows and disc-harrowing was started in November, 1923 and has been continued to date. In 1924 the area which had had farmyard manure was sown with *Crotalaria usaramoensis* and the rest with sunn hemp, which was ploughed into the soil at a later date. In the same year the lower branches of half of the trees which trailed on the ground were pruned and removed to facilitate weeding, cultivation and collection of fruits. In 1925 the plants which had a sickly yellow appearance were manured with bone meal at the rate of 2 lb. per tree. The manure was sprinkled round the plants and lightly forked in.

The Planet Junior cultivator is now being worked between the rows of limes instead of the disc-harrow. The latter is unsuitable as it banks up the earth around the plants and leaves drains in the rows.

A poor crop was obtained in 1926-27. It was largely due to a severe drought which caused the young fruit to fall before maturing. Irrigation was impossible owing to scarcity of water.

Irrigation was practised at other times. The method adopted was as follows. A trench about 1 foot wide and 4 inches deep was laid off parallel to the rows of the trees. A shallow hole was excavated round the base of each tree and the basins so made were connected with each other and with the long trench by short trenches between the trees. The basins could be cut off from the water supply by earth fillets. The following diagram shows the arrangement.



The number of vacancies supplied during the early stages is indicated by the fact that in 1926, eight years after the original planting, only 798 trees were in bearing out of a total of 1,158 trees.

Date.	No. of trees in bearing.	Average yield of fruits per tree.
1921-22	90	206
1922-23	155	308
1923-24	603	279
1924-25	702	484
1925-26	798	301
1926-27	755	164

The first crop was produced in 1921. There has been no difficulty in disposing of the fruit in the market at Anuradhapura. Traders from Jaffna, Trincomalie and Colombo have purchased large supplies at Rs. 10 per 1,000 delivered at the store of the Experiment Station. The principal fruit season is from August to November. Smaller crops have been obtained throughout the year.

Table A gives details of expenditure to date, table B gives details of yields, and table C of receipts from sales of fruit.

Table A.

Lime area = 6 acres; planted November, 1918.
Costs.

Period Oct. — Sep.	Planting & supplying vacancies.	Weeding	Cultivation, ploughing and disc-harrowing	Harvest- ing	Pruning	Irrigat- ing	Stump- ing	TOTAL Rs. cts.
1918—19	—	—	—	—	—	—	—	515 95
1919—20	38'99	654'25	—	—	—	—	—	693 24
1920—21	150'56	450'54	—	86'29	—	—	—	687 39
1921—22	132'18	1,179'80*	—	26'45	'90	—	—	1,339 33
1922—23	16'82	1,567'11*	—	—	133'68	455'76	56'96	2,230 33
1923—24	—	649'12	—	—	5 85	44'60	—	699 57
1924—25	—	253'87	47'34	86'18	53'84	93'85	—	535 08
1925—26	—	146'09	66'15	252'44	—	15'92	22'09	502 69
1926—27	24'86	234'69†	133'04	81'14	—	13'41	18'39	505 53

* This heavy expenditure was incurred in a study of the effect of clean weeding.

As a result of the experiments an economical system of ploughing and weeding with implements was evolved.

† Includes levelling earth banked round the trees by the disc-harrow.

Jungle clearing at Rs. 35/- per acre

Rs. 7,919 11

210 00

Table B.

Lime area = 6 acres ; planted November, 1918.

Yields.

Month	1921-22	1922-23	1923-24	1924-25	1925-26	1926-27
October	—	412	4,545	14,309	18,425	4,813
November	—	4,627	8,856	20,080	11,617	14,549
December	1,773	5,723	7,315	38,660	15,954	36,054
January	2,574	1,253	7,054	49,505	13,590	7,825
February	1,965	113	1,646	11,605	12,118	4,310
March	1,895	—	10,640	17,940	14,900	20,662
April	320	625	6,210	11,145	41,135	9,179
May	3,500	1,025	1,475	10,248	10,085	1,884
June	6,100	2,997	3,195	7,250	6,250	1,565
July	325	6,502	14,309	43,396	38,803	7,860
August	50	6,339	29,774	60,582	34,772	9,872
September	50	15,125	73,012	55,380	22,940	4,965
TOTAL	18,552	47,741	168,031	340,100	240,589	123,538

Table C.

Actual receipts from sale of limes.

Year	October	November	December	January	February	March	April	May	June	July	August	Sept.	Total
	Rs. cts.	Rs. cts.	Rs. cts.	Rs. cts.	Rs. cts.	Rs. cts.	Rs. cts.	Rs. cts.	Rs. cts.	Rs. cts.	Rs. cts.	Rs. cts.	Rs. cts.
1920—21	1'25	—	—	—	—	—	—	—	—	—	0'50	2'50	4'25
1921—22	0'50	10'00	2'37	0'37	1'85	25'75	—	13'61	40'43	—	10'13	—	105'01
1922—23	1'00	19'64	37'09	1'25	1'35	1'57	7'15	6'75	11'59	63'70	31'15	105'71	287'89
1923—24	31'39	60'97	53'96	56'72	13'64	89'56	37'55	1'50	9'15	64'75	126'82	271'73	817'74
1924—25	85'55	164'63	234'57	344'34	85'73	131'71	82'13	45'38	67'20	81'04	185'44	380'01	1887'73
1925—26	143'65	91'12	113'69	80'40	74'86	106'02	266'84	102'61	42'88	155'96	177'61	85'19	1440'86
1926—27	33'67	115'74	329'46	70'61	71'35	128'09	48'23	23'46	19'73	66'01	69'25	61'81	1037'41
													5580'89

Picked limes were sold at 75 cts. to Rs. 1/50 per 100 and dropped limes at 25 cts. to 60 cts. per 100. Selected fruits were used for seed purposes and are not included in the above table.

DISEASES.

Citrus canker (*Pseudomonas citri*) was found to be present in 1922, principally on the leaves, but one plant was seriously attacked on the branches. The latter became covered with rough warts and ultimately died back. The plant was dug up and burnt and the rest of the affected plants were sprayed. Pink disease (*Corticium salmonicolor*) also appeared but was soon brought under control.

In July 1925, a tree was found to be affected by *gummosis* and amputation of diseased branches and tarring of wounds were carried out. In June, 1926, several trees were dying back with appearance of the disease known as *wither-tip*. The wither-tip fungus, however, was not isolated from the diseased material. A bacterium which occurred upon affected twigs was tested in infection experiments with negative results. It was subsequently found that the trees were attacked by root disease caused by *Rhizoctonia bataticola*, a disease which is common among citrus in Ceylon. Forty one trees died out in 1926-27 and other twenty four are affected. The symptoms of the root disease are the gummosis and dieback already mentioned.