Republic of Lebanon
Office of the Minister of State for Administrative Reform
Center for Public Sector Projects and Studies
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الجمهورية اللبنانية
مكتب وزير الدولة لشؤون التنمية الإدارية
مركز مشاريع ودراسات القطاع العام

ECONOMIC ANALYSIS OF THE PRODUCTION OF ORANGES AND BANANAS IN DAMOUR AND SOUTH LEBANON

A

Joint Publication of the

Faculty of Agricultural Sciences
American University of Beirut
Lebanon

and

Bureau of Agricultural Economics
Joint Technical Service
Ministry of Agriculture
Republic of Lebanon

Publication No. 26
July, 1965

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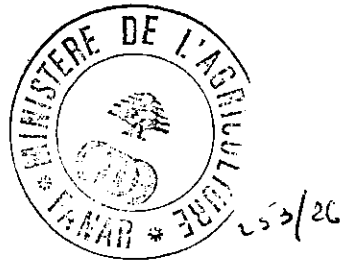

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BEIRUT, LEBANON

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ECONOMIC ANALYSIS OF THE PRODUCTION OF ORANGES AND BANANAS IN DAMOUR AND SOUTH LEBANON[1]

by

Joseph S. Fuleihan, Gordon H. Ward, Ramzi M. Khalidy,
Owen L. Brough, and Munif Taki[2]

PURPOSE AND OBJECTIVES

Citrus fruits are major crops in the coastal plain along the Mediterranean and one of the major exports of Lebanon. During the past decade banana production has grown by nearly 50 per cent. The prices of bananas have become more favorable for producers relative to citrus so that persons preparing to plant fruit trees in the coastal area are uncertain whether to plant citrus or bananas. Thus, it is important to assess the relative costs and returns from these two alternative crops.

Citrus and banana production has become increasingly important in the coastal plains of Lebanon during the last twenty years. The total area under citrus in Lebanon rose from 6,500 hectars in 1955 to 10,000 hectares in 1964. During the same period, the area devoted to banana production increased from 1,800 hectars to 3,000 hectars as is seen in Table 1.

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Table. 1 AREAS OF CITRUS AND BANANAS IN LEBANON, 1955-1964 IN HECTARS.

Fruit Crop	1955	1956	1957	1958	1959	1960	1961	1962	1963[a]	1964
Citrus	6,590	7,800	7,900	7,950	8,000	8,200	8,480	8,500	9,500	10,000[b]
Bananas	1,800	2,000	2,100	2,150	2,300	2.350	2,600	2,600	3,000	3,000[b]

a Ecimovic, Bulletin of Agricultural Statistics No. 1, Data for 1955-1963,
b Data of the Ministry of Agriculture.

It is estimated that over half of the present area planted with citrus and bananas is found in South Lebanon[1]. In recent years, the Akkar plain has witnessed the highest rate of expansion in citrus production. This expansion was mainly due to the potential of the citrus producing regions in the South and Mount Lebanon being almost fully developed, and land values becoming prohibitive. The citrus produciug region immediately around Tripoli, which has the oldest citrus trees in Lebanon, is gradually but steadily giving way to new residential areas. Thus, it is expected to become less important as a citrus producing area.

A survey[2] to ascertain the division of the area planted to various kinds and varieties of citrus, indicated that Shamuti and other winter varieties of oranges occupy about 5,750 hectars (57,500 dunums) while Valencias are planted on about 750 hectars. The area of oranges is thus estimated as 6,500 hectars. Lemons are grown on about 1,900 hectars and grapefruit on about 130 hectars.

Banana production has traditionally been restricted to the coastal strips of the South and to Mount Lebanon. Climatic conditions limit the commercial production of bananas in North Lebanon. Bananas planted on a trial basis in the Akkar plain have been unable to withstand successfully the climatic conditions of winds and winter cold. So far they do not show evidence of the possibility of competing with citrus for most profitable land use in that region.

Recent trends have favored expansion of banana production in those areas where it competes with citrus for highest land use returns, mainly

1) According to unpublished data collected by Mr. Said Baidas of the Lebanese Fruit Board.
2) Made by the Lebanese Fruit Board in September 1963.

in Damour and South Lebanon. This growth has been caused by an increasing cost of citrus production (mostly for disease control), a relatively lower price of citrus fruits, and profitable prices for bananas. These factors have caused some producers to remove their citrus trees and to replace them with bananas.

Since some farmers are planning to establish citrus or bananas orchards, it is important for them to assess which fruit is likely to be more profitable in the long run. Thus, there is need for economic data that reveal net returns from these fruits. The cost of developing a fruit orchard is high, and once the orchard is developed it becomes costly to use the land for other products. Farmers need information to help them make long-time investment decisions of whether to plant bananas or oranges. In addition, an analysis of the inputs used, the components of cost, and the total cost of production for each of these fruits can serve as a basis for determining how the costs of production can be reduced.

Objectives of the Study

1. To report the rates and costs of inputs used for the production of citrus and bananas in Damour and South Lebanon.
2. To compare the relative investment in orchard development, the relative growing costs, and components of costs for both fruits in the two regions.
3. To determine the "equal returns" selling prices for oranges and bananas under different sets of yield and cost price situations.
4. To prepare recommendations of possible ways of reducing the unit costs of production of each of these fruits.

SUMMARY

Citrus and bananas are major fruit crops in Lebanon. The area planted with citrus increased 50 percent during the decade 1955-1964 while the number of dunums growing bananas rose 65 percent. It is estimated that over half of these two crops is grown in the South Lebanon. With the expansion of the irrigated area in this region resulting from the Litani project, further expansion of citrus and bananas in South Lebanon is anticipated. About 60 percent of Lebanon's oranges and a slightly smaller percentage of bananas are exported. From 80 to 95 percent of the exports of these two fruits go to Arab countries.

Following the drop in wholesale prices of oranges in Beirut from an average of 37 piastres per kilogram for the years 1956-1958 to 29 piastres during the following three years, prices recovered to an average of 31 piastres for the years 1962-64. On the other hand, bananas registered a slight downward trend from an average of 55 piasters for the years 1955-1959 to 53 piasters average for the years 1960-1963. The relative improvement in orange prices since 1959 is shown by their ratio with banana prices. For the six winter months of 1961-62 banana prices were 214 percent of orange prices whereas for the 1963-64 winter harvest season wholesale banana prices were 171 percent of orange prices. In spite of this improvement in orange prices, bananas have been more profitable during the past decade so that in recent years the area planted to bananas has increased faster than citrus plantings.

The cost of producing a crop of oranges in Damour was found to amount to LL 1, 011 in 1963 and to LL 818 in South Lebanon. These were the averages of cost data collected from 12 growers in Damour ond 50 growers in South Lebanon. The higher cost in Damour was due to the materially higher value of land and the higher rate of wages paid to orchard workers and for cultural operations such as spraying and cultivation performed by contractors. There was no observable difference in annual care cost for orchards related to the amount of the harvest. Yield was the prime cause of variation in the cost of production of a kilogram of orangas. The cost per kilogram in Damour varied from 26 piasters when the yield was 3,900 kilograms to 34.5 piasters with a low yield of 2,900 kilograms. The per kilogram cost of production of oranges in South Lebanon was found to vary from 23 piasters

per kilogram with a yield of 3,600 kilograms per dunum to 31.5 piasters when the yield was 2,600 kilograms.

The direct costs of growing a crop of oranges constituted 43.5 percent of total cost in Damour area and 52 percent in South Lebanon. Fertilization, spraying, and cultivation were found to be the most expensive of the cultural operations. The higher annual fixed costs in Damour area were due primarily to the much higher value of land and cost of improvements which averaged LL 6,427 per dunum compared with LL 4,090 in South Lebanon. Interest on this investment amounted to LL 386 per year in Damour and LL 245 in South Lebanon. This interest was equivalent to an average of 11 piasters per kilogram for producers in Damour area and 8 piasters per kilogram of oranges in South Lebanon. Interest on the cost of growing the trees to the age of profitable bearing constituted 11 percent of the total cost of production in Damour and 9.5 percent in South Lebanon. Thus, interest on invested capital constituted 50 percent of the total cost of producing oranges in Damour and 41 percent in South Lebanon. Depreciation of the bearing trees represented 5.6 percent of total cost in Damour and 4.8 percent in South Lebanon.

The cost of planting a dunum of orange trees and caring for them for seven years was found to aggregate LL 2,847 in Damour and LL 1,953 in South Lebanon. This difference was due to planting 50 trees per dunum in Damour compared with 40 in South Lebanon and to the higher value of land and rate of wages in Damour. Bananas are planted among the young citrus trees in order to secure income to help pay the high costs of caring for the young citrus orchard. After the first year, the inter-planted bananas give a net profit over their cost of production ranging from LL 129 to LL 373 per dunum.

When bananas are planted alone, the cost of growing a dunum in 1963 in Damour was found to average LL 1,084 as compared with LL 918 in South Lebanon. The cost per kilogram from a low yield of 2,100 kilograms to a high yield of 3,100 kilograms was found to range from 32 to 46 piasters. The majority of producers of bananas in South Lebanon reported yields above the point of cost-price equilibrium. Producers in Damour need to achieve relatively high yields per dunum in order

to cover their higher costs. In the case of oranges, the yield at which the cost of production per kilogram equals the typical price of 20 piasters is far above what are regarded as high yields for both areas.

Examination of the costs of producing oranges in Italy, Spain, and the United States indicated that the cost of producing oranges in Lebanon is relatively higher than in these countries. The total costs of cultural operations performed by producers of oranges in Damour and South Lebanon in 1963 averaged LL 372 per dunum compared with LL 247 in Italy, LL 178 in Spain, and LL 197 in the United States. Several cultural operations were the main items of substantially higher cost in Lebanon than in these other countries. They included manure and chemical fertilizers, spraying against diseases and insects, cultivation, and weeding.

Whereas the annual fixed costs of depreciation and interest on the capital invested in the orange orchard constitute half or more of the cost of producing oranges in Lebanon, these fixed costs are in the range of 20 to 30 percent of the total cost of producing oranges in the United States. Depreciation of bearing trees averaged LL 47 per dunum in Lebanon and but LL 15 to LL 25 in the citrus areas of the United States. Seven years are needed to grow trees to profitable bearing in Lebanon in contrast with five years in the United States where trees are bought from nurseries one year after budding. Interest rates are 6 to 8 percent or higher in Lebanon in contrast with 5 to 6 percent in the United States. Compounding the interest during the seven year period of developing an orange orchard in Lebanon at about 2 percent higher interest cost adds a substantial amount to the cost of the bearing trees. The higher rate of interest in Lebanon combined with the much higher value of land and improvements makes the cost of owning citrus land in Lebanon about 10 times the cost in the United States. The annual interest on the capital invested in bearing orange trees amounted to LL 95 per dunum in Lebanon compared with an average of LL 21 in the United States.

The main opportunities for reducing the cost of producing oranges in Lebanon appear to be in reducing cultural costs, which constitute about 40 percent of the total cost per dunum, and obtaining higher yields. Two of the largest costs of cultural operations were found to be animal manure and cultivation by hand methods. Animal manure costs LL 71

per dunum annually. Hand cultivation costs three times more than machine cultivation and killing weeds with oil sprays or weedicide chemicals in the United States. Green manure crops grown among the trees during winter could be mixed into the topsoil mechanically at much less cost than animal manure and the same machine could replace expensive hand cultivation and weed control.

Lebanese citrus producers have been spending about twice as much as American producers for spraying, using materials which are considerably more expensive than other more effective chemicals, and making a larger number of sprayings than needed for effective control. Thus, by using oil sprays to control scale and sulphur for mites applied when insects appear, substantial reduction in the cost of spraying could be achieved.

Use of improved cultural practices can greatly increase yields of oranges in Lebanon. Careful selection of rootstock and scion combined with proper care result in higher yielding trees. Ample fertilization with animal or green crop manure with balanced amounts of chemical nutrients can produce a harvest of more than 4,000 kilograms of oranges per dunum. Shallow cultivation keeps the soil in proper condition for healthy growth of the tree and the fruits. Orange trees need to be irrigated at intervals to maintain adequate moisture for normal tree growth. Water should be applied in a way which does not puddle the soil and thereby reduce the supply of air reaching the roots. Ample drainage is essential to avoid water-logging the soil and drowning the roots of the trees.

Banana plants respond to cultural practices which foster healthy growth for producing large bunches of fruit. Bananas grow best in light soils with good water holding capacity. It is essential to regularly incorporate bulky organic matter into the soil. Sand should also be added to heavier soils. The application of adequate amounts of nitrate, phosphate, and potash chemical fertilizers is necessary for proper nutrition and high yield. Control of nematodes and replacement of deficient microelements also improves the nutrition of banana plants. Cultivation to a depth of 7 centimeters by light weight machines that do not compact the soil reduces the cost of production as compared to hand cultivation. For maximum yields, banana plants must be well protected from winds and irrigated frequently with moderate amounts of water.

Methodology

Research to find the costs of production and returns from citrus in South Lebanon was started in 1962 by Mr. Munif Taki who was then a graduate student in the Divisions of Agricultural Economics and Sociology and Crop Production and Protection at the American University of Beirut. This work was continued in 1963 as a joint project of the Bureau of Agricultural Econmics of the Lebanese Ministry of Agriculture and the American University of Beirut. It was then expanded to include the Damour region and Bananas to provide a comparative analysis between regions of production and crops grown, respectively.

In South Lebanon, individual producers were interviewed. Their reported costs were averaged for each item of cost as well as for total costs. Due to limited financial resources and personnel for interviewing individual producers, groups of three to six farmers were interviewed in Damour. Farmers in the group were asked to give the typical inputs for their region for each item of cost after they had discussed this cost among themselves.

Judgement was used in the selection of reliable and representative producers in the sample of farmers interviewed. Based on earlier experience, this method was believed to be both practical and accurate. First, the universe of citrus and banana producers was not known in advance, and the determination of this universe would have required more funds and personnel than were allocated for the study. Second, past experience had shown that some of the farmers chosen at random were uncooperative or unwilling to give cost information. Thus, in order to obtain figures on costs and returns those who are willing to supply the data have to be found and interviewed.

Much of the field work was done by Munif Taki, first in his capacity as a graduate student at the American University of Beirut, and later as Horticulture Engineer for South Lebanon with the Ministry of Agriculture. Mr. Taki was helped by other personnel of the Ministry of Agriculture, namely, Joseph Fuleihan, and Samah Farhat. The latter was statistical agent in South Lebanon. Meetings with farmers in Damour and South Lebanon were arranged by Isam Sfeir and Mustafa Hashisho, the extension agents in Mount Lebanon and South Lebanon respectively.

PRODUCTION AND EXPORTS OF ORANGES

While citrus is a major fruit in the agricultural production of Lebanon; the volume of oranges produced annually constitutes only about 2.5 percent of total orange production in the countries around the Mediterranean sea. The major producers in the Mediterranean region by importance are Spain, Italy, Occupied Palestine and Morocco. These countries each produce between 500,000 and 1,700,000 metric tons of oranges annually. By contrast the main winter crop harvested in Lebanon is in the range of 140,000 to 150,000 tons. The total production in the region during the 1964-1965 harvesting season is estimated to amount to about 5,300,000 tons as shown in Table 2.

Projections by the Commodities Division of FAO estimate that production in the countries around the Mediterranian will reach 6.6 to 7.5 million tons by 1970 with 3.6 to 4.0 million tons available for export. Production trends in the principal exporting countries indicate strenuous competition among Mediterranean citrus producers seeking outlets in European countries for their expanding outputs.

Production of Oranges in Lebanon

According to the Ministry of Agriculture, production of oranges in Lebanon increased from 100,000 metric tons in 1960 to 145,000 tons in 1964. These figures are shown in Table 3. This increase in tonnage harvested reflected the expansion of the area planted with orange trees from 8,200 hectares in 1960 to 9.500 in 1963 and 10,000 in 1964 as shown in Table 1. The recent expansion of the residential areas around Beirut, Tripoli, and Sidon has removed a substantial number of dunums of orange groves from commercial production. The area planted to new citrus groves in South Lebanon and in the Akkar Plain of North Lebanon has been slightly greater than that lost to the expansion of the coastal cities. Also, the lower returns per dunum from oranges compared with bananas has curtailed the planting of citrus trees in areas where bananas produce well.

Exports of Oranges

Table 4 reveals that Lebanon's orange exports increased nearly three fold during the decade 1955-1964, from 33,384 to 91,420 tons.

TABLE 2

PRODUCTION OF ORANGES DURING WINTER SEASON IN MAJOR PRODUCING COUNTRIES 1960-61 — 1964-65 NORTHERN HEMISPHERE, OCTOBER-NOVEMBER THROUGH MAY-JUNE[a]

Regions and Countries	1960-61	1961-62	1962-63	1963-64	1964-65
	(..... 1000 Metric Tons .....)				
North and Central America	4,919	5,931	4,792	3,962	5,008
United States	4,040	5,041	3,526	2,986	4,019
Mexico	766	772[b]	1,101[b]	800[b]	800[c]
Jamaica	48	72	92	91	102
British Honduras	30	2	31	35	37
Puerto Rico	29	30	33	38	38[c]
Trinidad and Tobago	6	14	9	12	12[c]
Mediterranean Region	3,948	4,459	4,230	5,233	5,298
Greece	189	207	213	202	256
Italy	741	799	712	929	994
Portugal	87	112	144	95	100[c]
Spain	1,272	1,685	1,195	1,726	1,622
Algeria	248	264	277	250	277
Morocco	410	404	440	545	532
Tunisia	63	57	41	60	52
Cyprus	40	56	44	61	62
Lebanon	98	125	104	140	145
Turkey	209	207	263	300	300[c]
United Arab Republic	210	158	255	348	305
Other	381	385	542	577	650
Other Regions	226	241	241	198	267
Japan	221	234	235	191	260
Philippines	5	7	6	7	7[c]
Total winter production	9,093	10,631	9,263	9,393	10,573

a FAO, CCP/Citrus/Outlook No. 5, Rome, Italy, December 10, 1964, p. 3.
b Changed basis of reporting production.
c Estimated.

TABLE 3

CALCULATION OF APPARENT CONSUMPTION OF ORANGES AND BANANAS IN LEBANON
1960 - 1964

	1960	1961	1962	1963	1964
Production of oranges[a]	100,000	127,000	133,000	150,000	145,000
Export of oranges[b]	63,380	49,851	89,629	87,475	91,420
Apparent consumption	36,620	77,149	43,371	62,525	53,580
Percent consumed in Lebanon	37	62	33	42	37
Production of bananas[a]	26,000	26,000	25,000	28,000	22,000
Exports of bananas[b]	15,322	16,398	15,853	16,671	14,328
Apparent consumption	10,678	9,602	9,147	11,329	7,672
Percent consumed in Lebanon	41	37	36	40	35

a Department of Statistics, Ministry of Agriculture.
b Statistique du Commerce Exterieur, Années 1960-1064, Conseil Superieur des Douanes, Republique Libanaise.

About 40 percent of current annual production is exported. Exports have expanded during the 1960's from 63,380 in 1960 to the 91,420 tons shipped during the calendar year of 1964. Thus, the increase in the past five years has amounted to 28,040 tons. Over this same period, exports to Western European countries decreased from 237 tons to 18 tons. Those to Eastern Europe dropped from 6,864 tons in 1960 to 3,451 tons in 1964. Exports to Bahrain, Jordan, Kuwait, Saudi Arabia, Sudan, and Syria increased by 32,946 tons, which was greater than the total increase in exports to all countries. Thus, over 95 percent of Lebanon's exports of oranges go to these six Arab countries.

Apparent Consumption of Oranges

Table 3 shows that apparent consumption of oranges by Lebanese consumers increased from 36,600 tons in 1960 to 53,600 tons during 1964. The apparent increase in consumption during the past five years,

TABLE

EXPORT OFORANGESROM LEBANON*

Countries	1955 Net tons	1956 Net tons	1957 Net tons	1958 Net tons	1959 Net tons	1960 Net tons	1961 Net tons	1962 Gross tons	1963 Gross tons	1964 Gross tons
Syria	18751	24104	24379	28463	35606	35947	31950	60051	58407	61639
Jordan	2260	3495	4114	5411	8622	11240	9459	16445	12548	7860
Kuweit	1157	935	2862	3112	3529	2481	2338	2213	1725	3289
Saudi Arabia	1144	1081	2655	1956	3501	4732	3787	7032	11692	12765
Bahrein	361	339	186	159	362	405	294	1047	995	1156
Katar	54	61	85	374	84	607	489	525	87	71
Iran	8	103	9	—	56	867	223	2	3	—
U. R. S. S.	3993	3855	3650	3623	2049	—	42	—	—	2691
W. Germany	12	355	430	1364	330	202	1	420	354	3
Belgium	1	1	—	—	—	—	—	—	—	—
Zcechoslavakia	5066	3018	2877	1773	102	2355	535	180	84	759
France	2	1582	60	45	1	35	30	1	48	15
Trieste	574	341	4	—	—	—	—	—	—	—
East Germany	—	1203	1638	1667	1198	3999	313	—	4	1
Rumania	—	254	150	—	—	410	277	—	—	—
Iraq	—	3	5	1	5	24	—	—	—	—
Egypt	—	24	—	—	3	—	10	—	—	—
G. Britain	—	53	—	17	706	1	—	5	23	1
Yuguslavia	—	392	344	—	561	—	—	—	—	—
Poland	—	—	472	270	68	—	—	1	—	—
Dubey	—	—	—	—	—	—	—	—	16	12
Italy	—	—	28	—	100	—	49	—	—	—
Switzerland	—	—	9	—	5	—	—	420	114	—
Abu Dbey	—	—	—	—	—	—	—	23	—	—
Sudan	—	—	8	—	—	—	151	521	697	1024
Sweden	—	—	—	—	11	—	—	—	259	—
Austria	—	—	—	12	—	—	—	232	—	—
Aden	—	—	—	19	21	—	—	—	—	56
Somalia	—	—	—	—	—	—	—	—	—	—
Singapour	—	—	—	—	—	66	—	—	—	—
Other countries	—	8	—	—	—	—	3	511	208	60
Total	33,383	41,207	43,957	48,566	6,920	63,371	49,851	89,629	87,264	91,420

*Statistique du Commerce Exterieur, Années 1955-1961, Conseil Superieur Danes, Republique Libanaise, 1962-64 from the Lebanese Fruit Board. Gross tons include the weight of the containers.

TABLE 3

EXPORTS OF BANANAS FROM LEBANON*

Countries	1955 Net tons	1956 Net tons	1957 Net tons	1958 Net tons	1959 Net tons	1960 Net tons	1961 Net tons	1962 Gross tons	1963 Gross tons	1964 Gross tons
Jordan	382	2700	3164	2928	1232	2335	7960	5084	7000	5791
Syria	4982	5922	4954	7949	5716	6727	6098	6810	7499	5800
Iraq	2107	1197	537	1919	3324	3854	1047	2630	1130	1588
Kuwait	629	549	791	547	157	87	141	28	49	34
Saudi Arabia	442	661	513	563	560	498	574	499	406	322
Cyprus	704	735	156	435	316	481	508	753	562	173
Iran	2	1	24	383	1143	1235	19	5	3	610
Egypt	140	—	—	—	—	—	—	—	—	—
Katar	20	134	20	27	32	63	37	27	6	—
Bahrein	1	6	8	21	9	5	8	10	8	5
Libya	5	—	5	115	111	23	—	—	9	—
Algeria	5	—	—	—	—	—	—	—	—	—
Greece	226	162	288	730	192	—	3	—	—	—
Trieste	7	—	—	—	—	—	—	—	—	—
Malta	243	25	339	130	7	12	—	—	—	—
Austria	—	—	10	—	—	—	—	—	—	—
Rumania	—	—	10	—	—	—	—	—	—	—
Sierra Leone	—	1	—	—	—	—	—	—	—	—
Aden	—	—	12	—	—	—	—	—	—	—
Pakistan	—	—	1	—	—	—	—	—	—	—
Rhoades	—	4	—	—	—	—	—	—	—	—
Turkey	—	—	—	—	—	1	—	1	—	—
Other countries	—	—	—	—	—	—	—	6	—	5
Total	9,895	12,097	10,832	15,747	12,799	15,321	16,395	15,853	16,672	14,328

*Statistique du Commerce Exterieur, Années 1955-60, Consiel Superior Douanes, Republique Libanaise, 1962-1964, from Lebanese Fruit Board. Gross tons include the weight of the containers.

even though prices were rising from 1960 through 1964, indicates a real increase in demand with consumers buying more oranges at higher prices. At prevailing prices, oranges appear to be a "good buy" in comparison with other fruits in the market at the same time. Comparing the apparent increase in consumption with the increase in exports since 1960, it appears that the demand for oranges in other Arab countries has been increasing faster than the local demand in Lebanon. Thus, export demand is an important factor in maintaining prices while production is growing.

PRODUCTION AND EXPORTS OF BANANAS

Table 1 reveals that the area planted to bananas was reported by the Statistics Department of the Ministry of Agriculture to have expanded from 2,350 hectares in 1960 to 3,300 in 1964. However, Table 3 shows that this expansion in area was not accompanied by a corresponding increase in the tonnage of bananas harvested. Winter storm damage in 1963 reduced the yield per tree so that the total harvest did not show as much increase as the expansion in the banana growing area. Storm damage was even more severe in 1964 to the extent that the harvest was 6,000 tons less from 300 more dunums that were producing bananas in 1963. The relatively higher prices for bananas compared with oranges during recent years have stimulated expansion of plantings in spite of the reduction of the harvest caused by winter storms and by "Banana Heart Rot" disease.

Export of Bananas

Banana exports from Lebanon, as shown in Table 5, increased from 9,895 tons in 1955 to 16,672 in 1963 but declined to 14,328 during the calender year 1964 due to winter storm damage to the crop. Nearly 95 percent of shipments abroad go to the Arab countries of Jordan, Iraq, Kuwait, Saudi Arabia and Syria. Jordan and Syria are the major foreign consumers of Lebanon's bananas. Together they take about 80 percent of the exports.

Apparent Consumption of Bananas

The figures for apparent consumption of bananas for the years 1960-1964 are shown in Table 3. They indicate a slight upward trend.

The small quantity consumed during 1964 was partly due to the crop being greatly reduced by winter storm damage. This low domestic consumption is considered abnormal. The reduced domestic consumption was evidently due to the substantially higher prices caused by the combined local and export demand competing for the small shipments reaching the markets. Exports have shown more growth than has apparent consumption in Lebanon.

The real increase in total demand for bananas in the local and export markets is indicated by the movement of 28,000 tons into consumption durin6 1963 at the same average price as the 26,000 tons marketed during 1960. The relative strength of the export demand is indicated by the fact that during 1964, when prices were 20 piasters per kilogram higher than the year previous, export buyers took 65 percent of the harvest compared with 60 percent of the much larger crop of 1963. The change in quantities exported from year to year relative to the price indicates that importing countries are taking the quantity of bananas they desire and Lebanese consumers take the remainder.

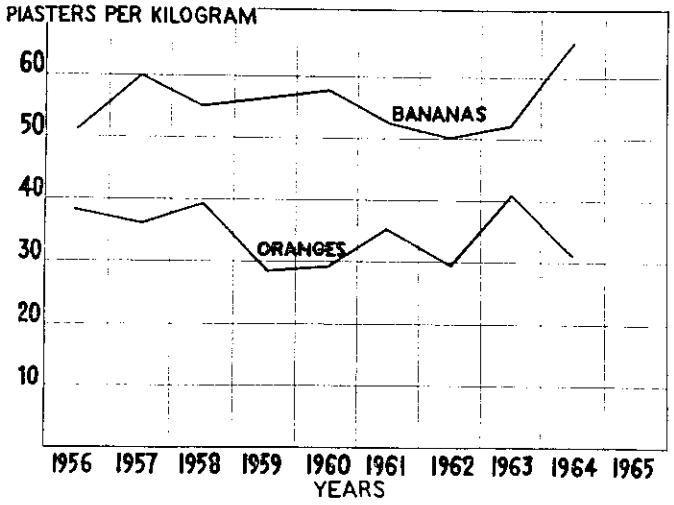
PRICES OF ORANGES AND BANANAS

The Ministry of Agriculture has collected prices of oranges and bananas in the Beirut wholesale market since the fall of 1955. Annual averages are shown in Figure 1. Monthly average prices are reported in Tables 6 and 7.

Analysis of yearly average prices of oranges in Table 6 reveals that prices dropped materially between 1958 and 1959, followed by a slightly increasing trend in more recent years. The average price for 1956-1958 was 37 piasters per kilogram. The average price for the next three years (omitting the abnormally high prices of summer months) was 29 piasters while for 1962 through 1964, the average (omitting summer months) was 31 piasters. The main crop of oranges is harvested and marketed by June. The small, but growing production of Valencias coming to market during the summer months brings prices much higher than fruit sold during the months of October through the following June. Late

FIGURE 1

YEARLY AVERAGE WHOLESALE PRICES OF BANANAS & ORANGES IN BEIRUT 1956-64



harvested Valencies are being held in cold storages to extend the marketing season into September.

Omitting the abnormally high prices of bananas following April 1964 due to storm damage the trend of prices shown in Figure 1 is slightly downward during the period of 1956 through 1963. Prices averaged 55.25 piasters per kilogram in the Beirut market during the years 1956-1959 compared with 53.25 piasters during 1960-1963. The average for the four years 1961-1964, including the abnormally high prices of the last year, was 55 piasters. This was slightly lower than the average for the period 1956-1959.

Prices of oranges increased about seven percent between 1959 and 1964 whereas banana prices decreased by a similar percentage during this period. Thus, orange prices when compared to those of bananas were relatively more favorable than in 1959-1960. However, they were relatively lower than during the period 1956 through 1958 when orange prices averaged 37 piasters per kilogram. The greater improvement in

TABLE 6

MONTHLY AVERAGE WHOLESALE PRICES OF ORANGES IN BEIRUT*

PIASTERS PER KILOGRAM

Oranges	1956	1957	1958	1959	1960	1961	1962	1963	1964
January	28	24	21	21	25	30	22	24	32
February	30	34	27	25	24	33	22	27	31
March	31	33	40	25	29	34	23	32	32
April	43	45	40	26	31	38	24	38	37
May	45	45	57	32	32	48	31	39	39
June	53	50	98	42	27	86	26	40	38
July	—	50	—	—	—	97	25	55	—
August	—	—	—	—	—	115	46	73	—
September	—	—	—	—	—	—	49	83	—
October	34	—	20	29	28	22	33	29	26
November	39	23	25	21	27	22	21	24	23
December	30	21	22	25	30	24	24	27	23
Year average	37	36	39	27	28	50	29	41	31

*Bureau of Agricultural Economics, Ministry of Agriculture.

TABLE 7

MONTHLY AVERAGE WHOLESALE PRICES OF BANANAS IN BEIRUT*

PIASTERS PER KILOGRAM

Bananas	1956	1957	1958	1959	1960	1961	1962	1963	1964
January	43	50	62	50	58	53	45	43	44
February	45	50	50	50	54	50	45	45	44
March	42	45	50	46	55	51	45	42	46
April	45	50	55	41	55	49	45	39	50
May	51	63	50	41	53	62	46	56	70
June	54	68	59	73	52	59	44	68	84
July	52	64	50	63	54	47	49	54	77
August	59	63	50	57	55	46	55	53	—
September	56	60	50	55	59	51	50	53	—
October	55	64	60	64	69	57	59	53	71
November	57	70	60	69	61	58	61	59	82
December	60	70	56	66	68	52	58	54	80
Year average	51	60	54	56	58	53	50	52	65

*Bureau of Agricultural Economics, Ministry of Agriculture.

orange prices, as compared to those of bananas, during the past three years is also shown by expressing banana prices as a percent of orange prices for identical periods of time. Banana prices for the six winter months of 1959-1960 were 240 percent of orange prices whereas for the 1963-1964 winter harvest season wholesale banana prices were 171 percent of orange prices.

Prices Received by Producers

Since there is no government system for recording prices received at the farm and because marketing agencies are reluctant to furnish prices paid farmers, it has been possible to obtain producer prices for bananas and oranges on a limited scale only. In January 1965, data on orange and banana prices were collected from producers in both Damour area and South Lebanon. Producer prices were collected from eight growers of bananas and eight growers of orangers in Damour and from 10 and 13 growers, respectively, in South Lebanon.

Oranges Prices

Prices of oranges received for fruit on the Beirut wholesale market during December 1964 were obtained from producers. However, there are three types of marketing costs which were deducted from the quoted wholesale price to the producer. First, a sales commission of 5 percent of returns was deducted by the sales agent. Second, a charge of 5 piasters per 24 kilogram box of fruit was levied to cover porterage costs in the market. Third, trucking charges of 30 piasters per box from Damour and 35 piasters from South Lebanon were deducted. After subracting these marketing costs, the price to producers of oranges in Damour and South Lebanon was 21.2 and 18.3 piasters per kilogram, respectively, during December 1964.

Comparison of the average net price of 21 piasters received by Damour producers with the average wholesale price of oranges in Beirut during December 1964 of 31 piasters showed a difference of 10 piasters per kilogram. The difference between the Beirut wholesale price for oranges and the average price received by growers in South Lebanon amounted to 13 piasters per kilogram. Assuming that this is a typical

average differential to cover transport and marketing charges, returns to producers in these two areas for oranges were calculated to be as follows :

Winter harvest seasons	1961-1962	1962-1963	1963-1964
Estimated returns in Damour area	12.4 pts.	17.1 pts.	20.6 pts.
Estimated returns in South Lebanon	9.4 pts.	14.1 pts.	17.6 pts.

Banana Prices

Most bananas are sold at the plantation through a commission agent to big wholesalers who supply the fruit and vegetable shops in Beirut, other consumption centers in Lebanon, and exporters and importers in various Arab countries. The producer is responsible for delivering the bunches of bananas to the buyer's truck at the nearest road. Banana wholesale merchants customarily subtract 2 percent of the weight delivered by each producer as an allowance for unsalable fruit in the bunches as cut from the trees. The producer pays a commission of 2 percent to the sales agent. Thus, there is a deduction of 4 percent from the gross value when computing net returns to producers. The price is traditionally set on the basis of a rattle which is roughly equivalent to 2.5 kilograms. The price per rattle is converted to price per kilogram using the standard of 39 rattles equal to 100 kilograms.

Converting the prices per rattle received by banana producers in December 1964 to price per kilogram and comparing the resulting average price with the wholesale price in Beirut for the month, it was found that the price to producers in Damour was 14.3 piasters below the Beirut price and 18.4 piasters lower in South Lebanon. Applying this same differential to the Beirut prices for bananas during the winter seasons of past years, the following estimated returns to producers occur.

Winter harvest seasons	1961-1962	1962-1963	1963-1964
Estimated producer price in Damour area	33.6 pts.	32.5 pts.	36.0 pts.
Estimated producer price in South Lebanon	29.5 pts.	28.4 pts.	31.9 pts.

COSTS AND RETURNS FROM GROWING ORANGES

The cost of producing a kilogram of oranges is related to the cost of growing an annual crop and to the number of kilograms harvested per tree and per dunum. However, the yield of oranges varies widely among orchards in a locality for any given year and from year to year. Thus, the cost of production per kilogram of harvested fruit differs greatly among producers in any one year and from one year to another. It is for these reasons that the 1963 costs of production per kilogram shown in Table 8 for Damour and the Sidon-Tyre area of South Lebanon are given for various yields in relation to the costs per dunum of 1000 square meters. The cost of production per kilogram can be compared directly with the price received by the producer.

COST OF PRODUCTION PER KILOGRAM OF ORANGES

The cost of producing a kilogram of oranges in Damour and in South Lebanon areas for each of three different levels of yields is shown in Table 8. The reported cost of producing a dunum of oranges for each of the two areas is taken from Tables 9 and 10. The three levels of yields were considered representative of low, medium, and high yields achieved by farmers in the two areas from whom data were obtained in 1963.

The total costs per kilogram in the Damour area ranged from 26 piasters per kilogram when the yield per dunum was 3,900 kilograms to 34.5 piasters with a low yield of 2,900 kilograms. The range for South Lebanon was from 23 piasters per kilogram with a yield of 3,600 kilograms to 31.7 piasters when the yield was only 2,600 kilograms. With a typical average harvest of 3,400 kilograms in Damour the cost per kilogram was 29.6 piasters compared with 26.6 piasters in South Lebanon for the average yield of 3,100 kilograms. The lower output per dunum in South Lebanon is related to the lesser number of trees per dunum. The average of the numbers reported by growers interviewed was 40 trees per dunum compared with 50 in the Damour area. The yield per tree in South Lebanon averaged 78 kilograms compared to 68 kilograms in the Damour area. Thus, total yield per dunum is most important in determining the cost of production of a kilogram of oranges when usual production practices are followed.

TABLE 8

COST OF PRODUCTION PER KILOGRAM OF ORANGES IN DAMOUR AND SOUTH LEBANON, 1963

	Damour Area*			South Lebanon*		
With a production cost per dunum of (Lebanese Pounds):	1,012			818		
If the yield in kgs. of oranges per dunum is:	2,900	3,400	3,900	2,600	3,100	3,600
Then various costs are as follows in:	Piasters Per Kilogram			Piasters Per Kilogram		
Total on-tree costs:	13.42	11.44	9.98	14.77	12.39	10.67
Costs of picking and hauling to the road	1.35	1.35	1.35	1.25	1.25	1.25
Annual fixed costs	19.68	16.79	14.63	15.03	12.61	10.86
Total of all costs	34.45	29.58	25.96	31.45	26.38	22.71
Total of all costs, except interest on land and improvements	21.55	18.38	16.03	22.01	18.46	15.89
Return to land and management at 20 pts. per kgs. of oranges	—1.55	+1.62	+3.97	—2.01	+1.54	+4.11
RETURNS PER DUNUM OF LAND WHEN THE PRODUCER RECEIVES 20 PIASTERS PER KILOGRAM OF ORANGES						
Amount of returns per dunum	LL—44.95	LL+54.95	LL+154.83	LL—52.26	LL+47.75	LL+147.96
Percentage returns on the investment in land and improvements	—0.70	+0.86	+2.41	—1.28	+1.17	+3.62

*See Tables 9 and 10 for itemized costs.

TABLE 9

COST PER DUNUM OF PRODUCING CITRUS IN DAMOUR REGION, 1963
12 ORCHARDS OF 15-20 DUNUMS, 50 TREES PER DUNUM

Annual Cultural Operations	Labor	Materials		Total Cost of Each Operation	
		Kind	Cost	Per Dunum	Percent
Cash Costs	Lebanese Pounds		Lebanese Pounds	Lebanese Pounds	
Fertilizing: 1¼ man-days at LL 6.00 per du.	7.50	Manure, ½ bag goat manure per tree every other year at LL 5.00 Chemical fertilizers 2½ kgs. ammonium sulfate at 16 pts. 1½ kgs. superphosphate at 11 pts. 1 kg. potassium chloride at 18 pts.	68.80 37.30	113.60	11.22
Spraying: 3 sprays at LL 6.00 per spraying	18.00	Materials Av. 2 sprays sulfur per year at LL 7.50 per spray per du. Av. 2 sprays organic phosphates at LL 16.50 per spray per du. Av. 1 spray oil at LL 15.00 per spray per du.	63.00	81.00	8.00
Irrigating: 10 times; 1 man at LL 6.00 for 5 du. per irrigation. Cleaning canals, 1 man at LL 6.00 for 3 du	12.00 2.00	Water cost	10.00	24.00	2.37
Cultivation and weeding: 3 times, total of 10 men at LL 6.00 per du.	60.00		. .	60.00	5.93
Pruning and removing branches: 2 men at LL 6.00 per du.	6.00	3 years. 150 supports at 10 pts. each.	8.30	14.30	1.41
Maintenance of windbreaks	1.50		. .	1.50	0.15
Guarding and supervision	40.00		. .	40.00	3.95
Repairs of buildings, irrigation facilities, fences, terraces, roads, and tools.	2.90	Cement, wood, metal parts, sand, stone, etc.	3.00	5.90	0.58
Spreading sand around tree	5.00	Sand (sand and spreading costs LL 150.00 per du. every 10 years; 2/3 of farmers use sand)	5.00	10.00	0.99
Miscellaneous labor costs	7.80		. .	7.80	0.77
Total costs of cultural operations	178.70		195.40	374.10	36.95
Interest on wages paid at 8% for 6 months	7.15	Interest on cost of materials at 8% for 6 months.	7.81	14.96	1.48
Total on-tree costs	185.85		203.21	389.06	38.43
Harvesting[a]: Picking for local market and hauling to the nearest road at 1.35 pts. per kg.	45.90	Harvesting materials	5.00	50.90	5.03
Total cash costs Labor	231.75	Materials	208.21	439.96	43.46
Annual fixed costs[b]					
Depreciation of:					
Irrigation facilities, fences, windbreaks, and hand tools				10.20	1.01
7 year old profitable bearing orchard costing LL 2,847.35 at 2% (50 years bearing life)[c]				56.95	5.62
Interest on:					
Investment in developed land, terraces, roads, and improvements (LL 6,427) at 6%				385.62	38.09
Half of the cost of irrigation facilities, fences, windbreaks, and hand tools (LL 72) at 8%				5.76	0.57
Half of the cost of developing bearing orchard, LL 1,423.68 at 8%				113.89	11.25
Total annual fixed costs				572.42	56.54
Total costs (excluding management) of the harvest delivered to the nearest road in the buyer's boxes				1,012.38	100.00

a Harvesting for the export market costs 2.7 — 3.2 pts. per kilogram of oranges.

b See Table 11 for calculations. Half of original cost represents the average investment during the life of the assets.

c See Table 12 for statement of costs.

TABLE 10

COST PER DUNUM OF PRODUCING CITRUS IN SOUTH LEBANON 1963
50 ORCHARDS OF 40 DUNUMS AVERAGE SIZE, 40 TREES PER DUNUM

Annual Cultural Operations	Labor	Materials		Total Cost of Each Operation	
		Kind	Cost	Per Dunum	Percent
Cash Costs	Lebanese Pounds		Lebanese Pounds	Lebanese Pounds	
Fertilizing: 1 1/3 man-days at LL 5.00	6.60	Manure, 1/3 bag goat manure per tree annually at LL 5.50 per bag. Chemical fertilizers 2½ kgs. per tree ammonium sulfate at 18 pts. per kg. 1½ kgs. per tree superphosphate at 11 pts. per kg. 1 kg. per tree potassium chloride at 18 pts. per kg.	73.20 31.80	111.60	13.65
Spraying: Average 4 sprays custom work, at LL 5.00 per du.	20.00	Materials Av. 3 sprays sulfur at LL 8.00 per du. per spray Av. 2 sprays organic phosphates at LL 15.4 per spray Av. 1 spray oil at LL 18.00 per spray	72.80	92.80	11.35
Irrigating: 10 irrigations at LL 0.75 per irrigation.	7.50	Water cost	12.00	22.00	2.69
Cleaning canals, ½ man-days at LL 5.00	2.50				
Cultivation : 2-3 times, total of 8 1/2 man-days at LL 5.00	42.50		. .	42.50	5.20
Weeding : 4 woman-days	10.00		. .	10.00	1.22
Spreading sand around tree	6.00	Sand : (sand and spreading costs LL 150.00 every 10 years ; 4/5 of farmers	6.00	12.00	1.47
[illegible] man-days at LL 7.00	[illegible]		. .	[illegible]	[illegible]
Propping : 3/4 man-days at LL 5.00	3.80	Supports : av. of 5 supports per tree, each lasts 3 years. 200 supports at 10 pts. each	6.70	10.50	1.28
Repairs to buildings, irrigation facilities, fences, terraces, roads and tools	4.30	Cement, sand, stone, metal parts, wood, etc..	4.60	8.90	1.09
Maintenance of windbreaks : 1/2 man at LL 150.00 per month for 50 du.	2.50		. .	2.50	0.31
Guarding and supervision : 1 man at LL 150.00 per month for 50 du.	36.00		. .	36.00	4.40
Miscellaneous labor costs	10.00		. .	10.00	1.22
Total costs of cultural operations	162.20		207.10	369.30	45.16
Interest on wages paid at 8% for 6 months	6.49	Interest on cost of materials at 8% for 6 months	8.28	14.77	1.81
Total on-tree costs	168.68		215.38	384.07	46.97
Harvesting[a] : Picking for the local market and hauling to the nearest road at 1.25 pts. per kg.	38.70	Harvesting materials	4.00	42 70	5.22
Total cash costs Labor	207.39	Materials	219.38	426.77	52.19
Annual fixed costs[b]					
Depreciation of :					
Buildings, irrigation facilities, fences, windbreaks, and hand tools				17.20	2.11
7 year old profitable bearing orchard (LL 1,952.67 at 2% 50 years productive life)[c]				39.05	4.78
Interest on :					
Investment in developed land, terraces, and roads (LL 4,090.00 at 6%)				245.40	30.01
Half of the cost of buildings, irrigation facilities, fences, windbreaks, and hand tools (LL 139.00 at 8%)				11.12	1.36
Half of the cost of developing the bearing orchard (LL 976.34 at 8%)				78.11	9.55
Total annual fixed costs				390.88	47.81
Total costs (excluding management) of the harvest delivered to the nearest road in the buyer's boxes				817.65	100.00

a Cost is 2.5 - 3.0 pts. per kilogram of oranges for export.

b See Table 11 for calculations. Half of original cost represents the average investment during the life of the assets.

c See Table 13 for statement of costs.

Analysis of the cost data presented in Tables 9 and 10 reveals that the annual fixed costs of depreciation and interest on capital constitute the largest single element in the cost of producing oranges in Lebanon. Depreciation and interest together amounted to more than the sum of the expenses for labor and materials for growing the crop of fruit.

Table 11 shows the calculation of the annual fixed costs based on the investment in land and the improvements for establishing the orchard, the buildings and other facilities, and the accumulated costs of the bearing trees. The data reveal that the high price of land was the largest factor in determining these fixed costs. The investment in developed land, terraces, roads, and other land improvements amounted to LL. 6,427 per dunum in the Damour area and LL. 4,900 in South Lebanon.

If interest on investment in land is omitted from the costs listed in Table 8, the total of all other costs was 18.4 piasters per kilogram for the typical average yield of 3,400 kilograms in Damour and 18.5 piasters for the typical yield of 3,100 kilograms in South Lebanon. Analysis of the various costs showed that when the price of oranges at the farm gate is 20 piasters per kilogram, producers will cover all production expenses except interest on the value of the land and improvements if they have a yield of 3,100 kilograms or more in Damour area or a yield of 2,900 kilograms or more in South Lebanon.

LOW RETURNS TO LAND

In order to secure a return of 6 percent on the high value of their land, orange growers in the Damour area would have to sell an average of 3,400 kilograms per dunum at 30 piasters per kilogram. Similarly, growers in South Lebanon need a price of 27 piasters to net 6 percent on the investment in their land. When the price of oranges is 20 piasters per kilogram at the farm gate, growers in Damour having average yields realize a return of 0.86 percent on the value of their improved land while those in South Lebanon earn 1.17 percent interest on money invested in land when interest at 8 percent on the investment in facilities, tools, and the bearing trees is included in expenses. At this price for oranges, producers having average yields in Damour have a return of 1.84 percent on the capital invested in the orchard after covering all

TABLE 11

CAPITAL INVESTMENT AND ANNUAL FIXED COSTS PER DUNUM OF CITRUS AND BANANA ORCHARD IN DAMOUR AND SOUTH LEBANON

CITRUS

Items	Damour					South Lebanon				
	Investement	Interest		Depreciation		Investment	Interest		Depreciation	
	LL	Rate	Amount LL	Rate	Amount LL	LL	Rate	Amount LL	Rate	Amount LL
Land, undeveloped	6,000.00	6%	360.00	—	—	3,500.00	6%	210.00	—	—
Terraces, roads, land preparation	427.00	6%	25.62	—	—	590.00	6%	35.40	—	—
Buildings	—	—	—	—	—	78.00	8%	3.12[a]	5%	3.90
Irrigation facilities	100.00	8%	4.00[a]	5%	5.00	150.00	8%	6.00[a]	5%	7.50
Fences and windbreaks	36.00	8%	1.44[a]	10%	3.60	42.00	8%	1.68[a]	10%	4.20
Hand tools	8.00	8%	0.32[a]	20%	1.60	8.00	8%	0.32[a]	20%	1.60
Developed orchard 7 years old	2,847.35[b]	8%	113.89[a]	2%	56.95	1,952.67[b]	8%	78.11[a]	2%	39.05
Totals	9,418.35		505.27		67.15	6,320.67		334.63		56.25

BANANAS

	Damour					South Lebanon				
	LL		LL		LL	LL		LL		LL
Land, undeveloped	6,000.00	6%	360.00	—	—	3,500.00	6%	210.00	—	—
Terraces, roads, land preparation	427.00	6%	25.62	—	—	590.00	6%	35.40	—	—
Sanding	100.00	6%	3.00[a]	5%	5.00	120.00	6%	3.60[a]	5%	6.00
Buildings	—	—	—	—	—	78.00	8%	3.12[a]	5%	3.90
Irrigations facilities	100.00	8%	4.00[a]	5%	5.00	150.00	8%	6.00[a]	5%	7.50
Fences and windbreaks	36.00	8%	1.44[a]	10%	3.60	42.00	8%	1.68[a]	10%	4.20
Hand tools	8.00	8%	0.32[a]	20%	1.60	8.00	8%	0.32[a]	20%	1.60
Banana orchard 1 year old	775.11[b]	8%	30.20[a]	5%	37.76	626.96[b]	8%	25.08[a]	6%	31.35
Totals	7,446.11		424.58		52.96	5,114.96		285.20		54.55

a Interest charged on half of original cost, representing average investment during the life of the assets.
b See Tables 12 and 13, 19 and 20 for the calculations of the costs of developing citrus and banana orchards.

other costs. Growers in South Lebanon have a return of 2.18 percent on the investment in their orchards.

A comparison of the prices of oranges over a period of years with the costs of production reported in Table 8 indicates that with average yields the net margin above expenses has not recently afforded a 6 percent return on the inflated prices of land in the citrus growing coastal areas of Lebanon. Citrus growers generally consider that the low return on the capital invested in land is compensated for by the continuing rise in land prices. The above analysis indicates that if Lebanon is to sell oranges in European markets, producers must accept a generally low return of 1 to 3 percent on their investment in land and the necessary improvements thereto. They may anticipate an additional return in the form of appreciation in the value of the land. However, this can be realized only when the orchard is sold at the enhanced land price.

To attain a return of 6 percent interest on the value of their land, when oranges net them 20 piasters per kilogram, producers in Damour would have to harvest 5,100 kilograms of oranges. Growers in South Lebanon would require a harvest of 4,100 kilograms per dunum to cover all costs. To attain such high outputs per dunum, yields of about 100 kilograms per tree would be required with the numbers of trees growing in existing orchards which were reported to average 50 in the Damour area and 40 in South Lebanon. Such a yield could scarcely be achieved with the present spacings between trees. Even if alternate trees were removed to permit greater growth of individual trees and if trees were sprayed more effectively, it is questionable whether the output per dunum required to net 6 percent on the current high values of land could be achieved. Output of citrus per dunum in other countries rarely exceeds 4,000 kilograms annually.

COSTS PER DUNUM OF PRODUCING ORANGES

The 1963 costs (excluding management) of growing a dunum of oranges in Damour and South Lebanon, as shown in Tables 9 and 10, totalled LL 1,012.38 and LL 817.65, respectively. These data were compiled from responses to interviews with 10 producers in Damour and 50 growers in the Sidon-Tyre area. Therefore, they can be considered as reasonably representative of the costs of growing oranges in those areas.

The tables present production costs grouped into two main divisions. They are the costs of the cultural operations of growing the annual crop of fruit and the annual fixed costs of depreciation and of interest on the capital invested in the orchard. To continue in production, growers must not only cover their out-of-pocket cash expenses for materials required for growing the fruit crop and protecting it from diseases and insect pests, but also their cost of labor to perform the various cultural operations and to harvest the fruit ready for sale to buyers. They also need to recover from the sales of the fruit any interest paid on operating capital borrowed to pay various expenses during the year.

To justify staying in production over an extended period of time, the prices received for the fruit must also cover depreciation on the value of fences, buildings, irrigation facilities, tools, and other productive assets used in the enterprise, including the accumulated cost of bringing the trees to profitable bearing size. Further, they should receive the current interest rate on the average capital invested in various facilities and bearing trees over their useful and productive life. If the net proceeds from the sale of the annual fruit crop, after paying direct expenses of growing the crops, yield only a low return on the capital invested in the land and improvements thereto, the owner may anticipate that he will obtain compensation from the rising value of the land.

Costs per Dunum

In Table 9 and 10 it will be noted that the total costs for cultural operations were LL 374 per dunum in Damour area in 1963 and LL 369 in South Lebanon. When the cost of interest on the operating capital used to pay these expenses during the year and the costs of harvesting the fruit ready for sale to buyers are added, the total cash costs were LL 440 in Damour and LL 427 in South Lebanon. The main reasons for the greater cost per dunum in Damour area were the higher wage rate of LL 6 per day compared with LL 5 in South Lebanon and the higher number of trees per dunum numbering 50 in Damour and 40 in South Lebanon. The costs of fertilizer, spray materials, and labor are proportionate to the number of trees per dunum.

The substantially higher annual fixed costs of LL 570 per dunum in Damour, as compared to LL 397 for South Lebanon, are due to the

much higher value of land and the higher cost of bringing the trees to profitable bearing age. Again, the higher cost of the developed orchard relates to the larger number of trees per dunum and higher wage rates in Damour. When interest on the inflated value of land is omitted from the annual fixed costs, they are reduced by LL 385 per dunum in Damour and LL 245 in South Lebanon. With the omission of interest on the inflated land value, the other necessary costs of growing an annual crop of oranges in Damour become LL 627 and LL 572 in South Lebanon. If oranges bring 20 piasters per kilogram at the orchard, the sale of an average yield of 3,400 kilograms per dunum reported for Damour and 3,100 kilograms in South Lebanon would cover necessary costs. A grower in Damour would receive LL 53 per dunum as a return on his investment in the land and a producer in South Lebanon would earn LL 48 as interest on his land.

Cultural Costs

Review of cost figures in Tables 9 and 10 reveals that major items of expense in the cultural operations for orange growing were fertilization, spraying for control of plant diseases and insects, cultivation and harvesting the fruit. These tables show the cost of the materials and labor used in their application to the land or to trees. Much of the labor is contracted and the worker is paid a standard sum per dunum for performing the operation. Rates and numbers of times that various operations were performed are shown in the tables.

1. Fertilizers

Producers of oranges used inorganic chemical fertilizers and substantial amounts of animal manures to maintain the required fertility in the soil. The use of animal manures improves the soil and supplies some of the required nutrients. Summer heat causes soil organic matter to decompose rapidly. Therefore, it needs to be replaced by applying animal manure annually.

The survey of orange growers conducted in 1963 showed that the use of organic manure varied in kind as well as in quantity according to the availability and cost of cow, goat, or horse manure. The majority of producers reported applying one-fourth to one-half of a bag of goat manure per tree annually in both Damour and South Lebanon.

2. Spray materials

The cost of spray material in the control of citrus diseases and pests has become quite appreciable in recent years. This is due to an increase in the population of citrus spider mites as a result of reducing the number of predators by using organic phosphorous spray materials to control scale, aphids, and other insects. Various farmers reported following different spraying practices and using different kinds and concentrations of spray materials to control the same disease. However, the majority applied two or three sprays of sulfur compounds, one or two sprays of organic phosphates, and one spray of oil. Their costs are reported in Tables 9 and 10. The higher cost of spray materials reported for South Lebanon was due to spraying with sulfur compounds one time more than farmers in Damour.

3. Sanding

Since orange trees grow better in lighter soils than in heavy clay, and since many soils in the Damour area in South Lebanon are too heavy for optimum growth of citrus trees, it was necessary to apply sand to improve the texture of the soil. An average application of sand was found to be about 5-7 centimeters in depth. When worked into the soil such an application improves the texture of the soil for about ten years. The cost of sand and labor for its application was found to average LL 150. However, only two-thirds of the farmers in Damour area and three-fourths of those in South Lebanon must apply sand to improve their soils. Accordingly, the annual charge for sanding amounted to LL 10 in Damour and LL 12 in South Lebanon.

4. Irrigation water

Most farmers in South Lebanon obtain water for irrigating their orange orchards from the Kasmieh Irrigation Project. They pay the Government a flat charge of LL 10 per dunum per year and are free to use as much water as needed by the trees. A few farmers pump irrigation water from wells. These growers reported substantially higher costs. The average cost of irrigation per dunum for farmers who supplied cost figures was LL 12.

Orchard owners in Damour have free access to irrigation water

from the Safa River. However, they pay an average of LL 10 per dunum per year toward the salaries of men who guard the channels to prevent improper diversion of water.

5. Props for heavy crops of fruit

When there is a heavy set of fruit on orange trees, the weight of the growing oranges may break the branches. Such breakage is prevented by supporting these branches with poles. Since some farmers did not use props for heavily ladened branches, the figures reported in the tables represent the average cost for all the producers who supplied expense figures for their operations.

6. Labor costs

Labor costs shown in the tables are averages for the farmers interviewed and include all labor used in production, regardless of its source. They consist of both hired and family labor. The wage assigned to family labor was established by using the daily rates of pay for comparable hired labor. It was decided to impute the cost of family labor as part of the cost of production because work done by members of the family would have to be replaced by hired labor in the absence of available family work force.

Damour, which is closer to Beirut, was found to have higher labor rates than South Lebanon where the number of workers is much larger. Operations in South Lebanon were charged at LL 5 per dunum whereas the charge in Damour was typically LL 6.

To minimize the work of spraying, citrus producers often combine different spray materials in a single application for control of various diseases and insects. This practice reduces the number of sprays to three or four per year. In South Lebanon much of the spraying is done by custom operators who charge a flat rate per dunum for both labor and materials. To make cost statements for Damour and South Lebanon comparable, the costs of labor and materials were calculated separately for the custom operators using data obtained from producers who did their own spraying.

Most farmers prune their citrus trees lightly each year to remove old and dead branches. Corrective pruning is done every few years.

The cost of pruning is quite variable among farmers in the same region, as well as between Damour and South Lebanon. These variations are due primarily to differences in wage rates and the amount of wood to be cut from the trees, the age of the trees, and distance between trees.

Data collected from farmers who perform their own harvesting and marketing and that obtained from contractors who purchase the fruit crop in an orchard prior to harvest showed that picking the oranges and moving them to the nearest road cost an average of 1.25 piasters per kilogram. It is at this point that buyers pick up the fruit and pay the "farm gate" price. This price is expected to cover the costs of producing and harvesting the oranges as well as to provide the owner with a profitable return on his invested capital and with compensation for his management.

The cost of picking citrus for export is higher than for fruit sold in the domestic market. Fruits for export must be picked with clippers which cut the stem close to the orange. They must also be handled carefully to avoid bruising. Consequently, the cost of harvesting given in the tables is for fruit sold locally.

The cost of guarding the orchard and supervising workers who perform cultural operations is related to the size of the plantation. Usually one man is hired to do this work for a particular orchard. His salary is usually a set amount per month. He may also perform other duties such as irrigating and harvesting. The labor cost for these other operations has been charged to each operation so that the correct cost of guarding and supervision can be shown in the tables of cost of production. The usual salary for the guard-supervisor is LL 150 per month. In South Lebanon it is typical that he looks after a grove of 50 dunums whereas in Damour the size of grove is considered to average 45 dunums. The annual cost per dunum was calculated on this basis.

Experience in past studies of costs and returns has shown that where the total labor cost is developed by adding the individual costs for each cultural operation, a small quantity of what might be called "overhead labor" is not accounted for. This amount includes the time required for workers to travel to the field, to prepare

their tools for use, or to change from one job to another. It is included in the tables of costs as "miscellaneous labor". The charge was calculated at an arbitrary 5 per cent of the total non-custom labor costs.

7. Interest on operating capital

Farmers pay money for materials and labor thoroughout the year. Many producers must borrow part or all of the money used to pay expenses of producing a crop of oranges. Those who borrow operating capital have to pay an average of around 8 percent. The interest they pay for this operating capital is one of the costs of producing the crop. Farmers who use their own money to pay production expenses are entitled to the same interest rate on their funds as are those farmers who borrow. Those who do not need to borrow would earn interest on their money if they invested it in some other business enterprise. Since the money to pay expenses is advanced periodically during the year, it was believed that interest should be charged for six months so as to represent the average time that money was used in financing the growing of the crop. This interest cost constituted 1.5 percent of the total cost of production in Damour and 1.8 percent in South Lebanon.

8. Total on-treegrowing costs

The total on-tree costs are the sum of all material and labor costs plus the interest on the operating capital used to pay expenses of cultural operations. They amounted to LL 389 per dunum in Damour area and LL 384 in South Lebanon. The higher cost of producing a crop of citrus in Damour was due to higher rate of wages making the total labor cost per dunum of orchard LL 10 greater than in South Lebanon. However, it was found that growers in South Lebanon spent more for spray materials, thus reducing the difference between their total costs and those in Damour area. These differences in costs between the two areas are evident in Tables 9 and 10.

Annual Fixed Costs

Although frequently overlooked by producers when estimating their costs of producing citrus, annual fixed costs of depreciation and interest accounted for about half of the total cost of producing oranges in Lebanon

according to figures collected from producers in Damour and South Lebanon. They constituted 56.5 percent of the costs in Damour area and 48.2 percent in South Lebanon. Therefore, it seemed important to analyze these fixed costs and to reveal reasons why they were such a large part of the total costs of production. These costs are considered as fixed because they are a fixed amount each year regardless of whether the harvest is large or small.

The calculations of the annual fixed costs for a dunum of citrus orchard in Damour and South Lebanon are shown in Table 11. In both areas interest on the current value of the land constituted the largest single item of annual cost. Interest on the investment in land accounted for 38 percent of total costs in Damour and 30 percent in South Lebanon, where prices of land average two-thirds of those in Damour. Depreciation amounted to but a sixth or a seventh of the total amount of annual interest cost. Taxes on farm land are not listed in Table 11 because they have been suspended since 1958 when substantial losses were suffered by farmers during the civil strife.

The figures for the average price of undeveloped land shown in this table are averages of prices reported by owners of the orchards. Land prices vary according to location, soil, availability of water and other factors.

1. Depreciation

Depreciation of the irrigation facilities, fences, windbreaks, buildings, handtools, and the bearing trees constitutes 5.6 to 7 percent of the total cost of growing oranges in Lebanon. Depreciation of the trees amounts to 5 to 5.6 percent of the total cost of production.

Buildings, irrigation facilities, machinery, fences, tools, and similar assets used in producing oranges and other farm products decrease in value every year because they wear out. Each kind and type of them have a definite number of years of useful productive life. Buildings made of concrete blocks and tile roofs are considered to have an average useful life of about 20 years and are depreciated at the rate of 5 percent annually, using the straight line method of calculating depreciation. Handtools have been found to wear out in about five years, on the average, and so they are depreciated at the rate of 20 percent per year.

Depreciation was calculated on the original cost price of the various items which diminish in productive value over time at a rate determined by their years of useful life. The rate was figured by dividing the number of years of expected useful life into 100. Thus, 5 percent depreciation was charged on irrigation facilities lasting 20 years. The original costs are those reported by the farmers interviewed.

Bearing trees represented the largest single item of depreciation. The annual rate of depreciation of profitable bearing orange trees was assumed to be 2 percent annually, based on the observed average profitable productive life of about 50 years. Some orange orchards produce longer, but many older trees do not yield a sufficient quantity of fruit to cover the annual care-costs. While it is true that orange trees normally reach full bearing at 10 to 12 years of age, if the depreciation is spread over the remaining 40 years of productive life, the annual rate of depreciation has to be increased to 2.5 percent. It is simpler to use the straight line method for calculating the average cost of production of oranges over the entire period of 50 years of profitable production. By charging 2 percent of the cost of bringing the trees to profitable bearing as an expense for producing each annual crop, enough money will be accumulated in the reserve for depreciation at the end of 50 years to pay the expenses of developing a new orchard. Only by including this depreciation of the bearing trees as one of the costs of producing oranges can producers recover the money they spent to care for the young trees during the seven years they were growing to profitable size.

2. Interest on investment

Data presented in Tables 9 and 10 show that interest on the investment in an orange orchard constitutes 40 to 50 percent of the total cost of growing the annual crop of fruit. Interest on the money invested in the land and the bearing trees is the largest single item of cost.

Interest on borrowed money and on money invested in a production enterprise by a farmer are considered important elements in the cost of production of farm products. Interest paid for the use of borrowed capital is a direct expense that must be paid regard-

less of the size of the harvest. Money which the farmer puts into financing his farming business operation is likewise considered a fixed cost. It is properly included in the cost of production because the business would have to pay interest if the money were borrowed rather than coming from the farmer's savings. Furthermore, if he invested his money in some other business he would not only receive interest but also would likely obtain substantially larger profits.

The rate used for calculating interest cost on the capital invested in land, land improvement and irrigation facilities was estimated to average 6 percent per annum. Farmers can borrow from the Credit Bank for Agriculture, Industry, and Real Estate (BCAIF) on the security of a first mortgage on their land for an annual charge of 5.5 percent. The rate employed in the calculations was increased to 6 percent to allow for higher rates paid by the farmers borrowing from other sources.

The rate of 8 percent was used for calculating the annual interest cost on capital invested in buildings, irrigation facilities, fences, windbreaks and handtools because the amount which a farmer can borrow from the BCAIF is limited to about one-third of the current value of agricultural land. Accordingly, producers have to borrow much of the required money from other sources at higher rates.

It is standard practice in calculating interest for estimating the cost of producing a farm product to use half of the original cost of assets which depreciates in value as the figure on which to base the multiplication. The average investment during the productive life of a building, a machine, or a fruit tree is the average of the cost price at the beginning when it is first put into use and its value at the end of the period when its market price is virtually zero.

3. Investment on land

Interest on the investment in land alone constitutes 30 to 38 percent of the total cost of production. Thus, it is clearly evident that the high cost of land is responsible for a large part of the high fixed costs in orange growing. If interest on the very

high cost of land is to be included in the cost of producing citrus to determine the price which must be charged, then Lebanese producers will be forced to price their oranges out of world markets.

Interest on the investment in land was calculated at 6 percent because this was found to be rather typical of the charge paid for capital for long term investments. Short term borrowing typically cost 8 percent aunually.

4. Investment in bearing trees

Interest in the average investment in the bearing trees to pay the cost of seedlings, planting expenses, and annual care-costs for seven years is an important cost item in producing oranges. Interest on this investment amounted to 10 percent of all costs for South Lebanon and 11 percent for producers of oranges in Damour area. However, it amounted to a third or less of the interest on land value and ranked with the cost of fertilization in its importance relative to the total cost of production.

Interest was charged on the basis of cost prices reported by farmers who supplied figures for their investment in orange orchards in Damour and in South Lebanon. The figures listed in Table 9 for the investment in a dunum of developed orange orchard in Damour and in South Lebanon are the total net costs of planting the trees and caring for them through seven years. The quantity of fruit harvested in the eighth year ordinarily is sufficient to pay for the annual care and fixed costs, as shown in Tables 12 and 13. Money received from the sale of oranges beginning with the fourth or fifth year and that received annually from the sale of bananas interplanted with the orange trees was credited against the annual care costs. These credits substantially reduce what would otherwise be a much higher cost of growing a dunum of profitable bearing citrus trees. If producers would be willing to accept 6 percent interest instead of the prevailing 8 percent on money they invested in bringing their orange trees to profitable bearing age, the cost of interest on this investment would be reduced by one-fourth. This reduction would

lower the total cost of production by 2.5 percent for South Lebanon and 2.8 percent for Damour. The cost per kilogram would be reduced by 0.7 of a piaster in South Lebanon and 0.8 of a piaster in Damour area for producers having the average yield mentioned earlier.

Total Production Costs

The component parts of total production costs, excluding management, are the sum of all growing and fixed costs. The total cost per dunum in Damour was found to be LL 1,012, or LL 194 greater than the average cost of LL 818 for the orchards surveyed in South Lebanon. All but LL 5 of this excess was due to the substantially greater fixed costs of producers in the Damour area. They had a much higher annual interest cost on the investment in land and improvements because their average investment in land and improvements was LL 6,427 compared with LL 4,090 in South Lebanon. Interest on the cost of developing orange trees to a profitable bearing age was also found to be LL 44 higher for Damour growers. As stated previously this greater cost to Damour growers was due to higher wage rates paid to workers performing the cultural operations in the orchards and to the fact that there were 10 more trees per dunum in Damour orchards than in those of South Lebanon.

Yearly growing costs do not vary much from year to year because the fixed costs continue the same and the same cultural operations have to be performed. However, yields differ greatly from year to year, due primarily to natural causes beyond the control of the producer. The effect of the number of kilograms of oranges harvested upon the cost of production per kilogram of fruit sold is shown in Table 8.

COST PER DUNUM OF DEVELOPING AN ORANGE ORCHARD FROM PLANTING TO PROFITABLE BEARING AGE

The costs of planting a dunum of orange trees and caring for them for seven years, the period required for a harvest of fruit sufficient to pay the total annual production expenses, are shown in Tables 12 and 13 for Damour and South Lebanon, respectively. In this tabulation of accumulating costs, credit is allowed for the value of the oranges produced by the young citrus trees beginning with the fourth or fifth year and for the annual yield from the banana trees planted among the citrus. The banana trees are usually removed when they are crowded out by the growing orange trees. All interplanted banana trees are normally removed by the end of the seventh year. However, when banana prices are quite profitable, some producers postpone the removal of the banana trees for a year or two in order to realize maximum profits from the interplanted bananas, but at the expense of the developing orange trees.

The cost of land and preparing it for planting; constructing necessary terraces, roads, irrigation facilities, buildings, and fences; planting windbreaks; and purchasing needed tools amounted to LL 6,571 per dunum in Damour area and LL 4,368 in South Lebanon. Since these items are used for the trees during their entire life, the total cost is considered as a permanent investment rather than as part of the cost of the trees at profitable bearing age. The annual fixed costs of interest on the invested capital and of depreciation on the items other than land and improvements are included as part of the costs for each of the years of the development period, as shown in Tables 12 and 13. Farmers establishing new orange orchards plant one to two year old sour orange seedlings. A year later these seedlings are budded to the desired variety. These seedling and budding costs are listed for the first and second years of the development period and are in addition to the costs of regular annual cultural operations incurred when caring for the growing trees.

The costs for various materials applied to the land and to the young trees shown in the tables are those secured from farmers having young orchards under development in 1963. Quantities of animal manure,

TABLE 12

COSTS OF DEVELOPING A DUNUM OF PROFITABLE BEARING ORANGE ORCHARD IN DAMOUR AREA, 1963. FIVE ORCHARDS OF 15 TO 20 DUNUMS, 50 TREES PER DUNUM, PLANTED 4.5 BY 4.5 METERS

	Annual Costs Per Dunum in Lebanese Pounds						
	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year
Total initial investment[a]	6,000.00	..	..	..	..	..	..
Annual cultural operations							
Materials							
Seedling trees at LL 1	50.00	..	..	..	..	..	..
Stakes for young trees	7.00	..	..	..	..	..	..
Animal manure	20.00	30.00	30.00	36.00	48.00	60.00	68.00
Chemical fertilizer	6.00	8.00	9.00	10.00	20.00	25.00	30.00
Spray materials	1.00	4.00	8.00	16.00	30.00	40.00	50.00
Water (50% of LL 10 charge)	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Sand	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Harvesting materials	..	..	..	..	1.00	2.00	3.00
Props for supporting branches	..	..	..	..	..	3.00	5.00
Total cost of materials	95.00	53.00	58.00	73.00	110.00	141.00	167.00
Labor							
Layout and plant 50 trees	50.00	..	..	..	..	..	..
Budding seedling trees	..	1.50	..	..	..	..	..
Spreading manure and fertilizers	4.00	5.00	5.00	5.50	6.00	6.50	7.00
Spraying	1.00	2.00	5.00	7.00	9.00	12.00	15.00
Irrigating	8.00	8.00	8.00	8.00	9.00	10.00	11.00
Cleaning irrigation canals	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Cultivating and weeding	30.00	35.00	40.00	42.50	45.00	46.00	48.00
Spreading sand around trees	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Pruning	1.00	2.00	3.00	4.00	6.00	9.00	12.00
Tending windbreak trees	5.00	5.00	3.50	2.50	1.50	1.50	1.50
Placing props under branches	..	..	..	..	..	1.00	2.00
Harvesting for the local market (1/10 of salary)	13.00	13.00	13.00	13.00	13.00	13.00	13.00
Total labor costs	120.00	79.00	85.50	93.00	106.50	126.80	159.10
Total cost of cultural operations	215.00	132.50	143.50	166.00	216.50	267.80	326.10
Annual fixed costs[a]							
Depreciation of irrigation facilities, etc.	10.20	10.20	10.20	10.20	10.20	10.20	10.20
Interest on:							
Beginning investment	391.38	391.38	391.38	391.38	391.38	391.38	391.38
Accumulated costs through previous year at 8%	..	100.60	123.92	123.92	150.03	179.78	209.93
Half of cost of operation for the year at 8%[b]	8.60	5.30	5.74	6.64	8.66	10.71	13.04
Repairs to fences, etc.	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Total annual fixed costs	413.18	481.29	510.92	535.14	563.27	595.07	629.15
Total cost for the year	628.18	613.79	654.42	701.14	779.77	862.87	955.25
Yield in kgs.	..	..	..	160	660	1,430	3,080
Credit for fruit at 20 pts. per kg.	..	..	..	32.00	132.00	286.00	616.00
Net cost of care of orange trees	628.18	613.79	654.42	669.14	647.77	576.87	339.25
Credit for net returns from interplanted bananas (Table 14)	−264.47	248.86	362.99	342.76	275.94	179.93	136.06
Net costs for each year	892.65	364.93	291.43	326.38	371.83	396.94	203.19
Accumulated net cost of citrus orchard	892.65	1,275,58	1.549.01	1,876.39	2,247.22	2,644.16	2,847.35

a See Table 11 for list of items of initial investment and calculation of fixed costs.
b Total cost of cultural operations less harvesting costs. Expenses are paid throughout the year.

TABLE 13

COSTS OF DEVELOPING A DUNUM OF PROFITABLE BEARING ORANGE ORCHARD IN SOUTH LEBANON, 1963,19 ORCHARDS OF 27 TO 35 DUNUMS, 40 TREES PER DUNUM, PLANTED 5 BY 5 METERS

	Annual Costs Per Dunum in Lebanese Pounds						
	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year
Total initial investment[a]	4,368.00	..	..	..	..	..	..
Annual cultural operations							
Materials							
Seedling trees at LL 1	40.00	..	..	..	..	..	..
Stakes for young trees	7.00	..	..	..	..	..	..
Animal manure	17.00	25.50	25.60	26.00	40.20	47.50	51.50
Chemical fertilizer	4.50	6.00	6.50	10.00	14.20	15.40	17.20
Spray materials	..	3.33	8.45	14.00	21.15	27.00	32.70
Water (50% of LL 12)	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Sand	60.00	..	..	..	..	..	..
Harvesting materials	..	..	..	..	1.00	2.00	2.50
Props for supporting branches	..	..	..	..	2.00	3.00	5.00
Total cost of materials	134.00	40.83	46.55	56.00	84.55	99.90	114.90
Labor							
Layout and plant 40 trees	40.00	..	..	..	..	..	..
Budding seedling trees	..	2.52	..	..	..	..	..
Spreading manure and fertilizer	3.80	4.00	4.20	4.50	4.70	4.80	4.90
Spraying	..	1.67	5.25	6.00	6.35	8.00	9.80
Irrigating	10.30	11.60	11.60	11.60	11.60	11.60	11.60
Cleaning irrigation canals	1.70	1.70	1.70	1.70	1.70	1.70	1.70
Cultivating and weeding	35.60	42.20	47.20	48.50	49.10	49.80	49.80
Spreading sand around trees	60.00	..	..	..	..	..	..
Pruning	..	3.80	4.90	5.40	5.80	6.00	8.10
Tending windbreak trees	3.00	3.00	2.00	1.00	1.00	1.00	1.00
Placing props under branches	..	..	..	..	1.50	2.00	3.00
Harvesting for the local market (1/3 of salary)	12.00	12.00	12.00	12.00	6.50	12.60	23.30
Total labor costs	166.40	82.32	88.85	90.70	99.25	109.50	121.20
Total cost of cultural operations	300.90	123.15	135.40	146.70	183.80	209.40	236.10
Annual fixed costs							
Depreciation of buildings, etc.	17.20	17.20	17.20	17.20	17.20	17.20	17.20
Interest on :							
Beginning investment	256.52	256.52	256.52	256.52	256.52	256.52	256.52
Accumulated costs through the previous year at 8%	..	68.05	87.04	97.67	112.04	127.58	145.04
Half of cost of operation for the year at 8%[b]	12.04	4.93	5.42	5.87	7.35	8.38	9.44
Repairs to buildings, etc.	4.60	4.60	4.60	4.60	4.60	4.60	4.60
Total annual fixed costs	290.36	351.30	370.78	381.86	397.71	414.28	432.80
Total costs for the year	591.26	474.45	506.18	528.56	581.51	623.68	668.90
Yield in kgs.	..	..	..	..	560	200	2,000
Credit for fruit at 20 pts. per kgs.	..	..	..	..	112.00	20.00	400.00
Net cost of care of orange trees	591.26	474.45	506.18	528.56	469.51	403.68	268.90
Credit for net returns from interplanted bananas (Table 15)	−259.31	237.04	373.23	349.01	275.27	185.46	129.17
Net costs for the year	850.57	237.41	132.95	179.55	194.24	218.22	139.73
Accumulated net cost of citrus orchard	850.57	1,087.98	1,220.93	1,400.48	1,594.72	1,812.94	1,952.67

a See Table 11 for list of items of initial investment and calculation of fixed costs.

b Total cost of cultural operations less harvesting costs. Expenses are paid throughout the year.

inorganic fertilizer, and spray materials applied increase from year to year in proportion to the growth of the trees. The amounts of labor required for performing various operations such as spreading manure and fertilizer, cultivating and weeding, also increase annually.

The annual charge for irrigation water per dunum of land is LL 10 regardless of the number of trees on each dunum. Therefore, the orange trees were charged with but half of this annual expense. The other half was charged against banana trees interplanted in the orchards. The LL 6 annual charge for water for the young orange trees in South Lebanon reflects the higher cost of pumping experienced by those growers who do not obtain water from the Khasmieh irrigation scheme.

Different costs of purchasing and applying sand to young orange trees were charged in the two locations. In Damour, most orchards are sufficiently close to the seashore that farmers can haul sand on the backs of donkeys when they are not busy with other work. Accordingly, this operation has been charged on an annual basis. In South Lebanon enough sand is worked into the soil to lighten it for good root growth over a period of ten years. Thus, for South Lebanon, the cost of purchasing and spreading the sand has been charged to the first year. This sanding operation will be repeated after ten years and the cost amortized as an annual expense charge in the costs of producing oranges.

The expense for tending trees in the wind break decreases over the first four years as the seedlings are thinned out, they become established and require less care. It is quite important for obtaining high yields to protect the citrus orchard from winds.

Irrigation canals and channels conducting water to ditches and furrows leading to the trees must be cleaned annually. This expense is uniform from year to year regardless of the size or age of the orchard trees. In addition, the man who guards the orchard and supervises workers who perform many of the cultural operations is paid by the month irrespective of the size of the orange trees. One third of his monthly salary was charged to the young citrus trees and two thirds to the interplanted bananas because the latter were producing a crop that brought in revenues greater than the expenses.

The annual fixed costs of interest on the money invested in land, improvements, buildings, and estimated annual expense for repairs continue the same each year. The interest on operating capital for paying the costs of various orchard operations varies with these fixed costs from year to year. No interest is charged on money paid for harvesting the oranges because this expense occurs close to the time that income is received from the sale of the fruit. As in the case of the annual expense calculation for crop production, interest is charged on half of the yearly expenses because these are paid from time to time during the year rather than at the beginning.

Due to receipts from the sale of oranges not covering annual costs of orchard care until the trees are seven years old, costs accumulate year after year during the first seven years. Thus, interest on the net accumulated costs of the growing citrus trees through the end of the previous year is included as a cost for the following year. Therefore, a compound interest charge builds up during the seven years as part of the total net cost of bringing the trees to profitable bearing age.

The cost of developing a dunum of orange trees to the age of profitable bearing was found to average LL 2,847 in the Damour area and LL 1,953 in South Lebanon. Part of the higher cost in Damour is due to planting 50 orange trees on a dunum of land whereas in the South Lebanon, 40 trees are planted per dunum. The other major factor is the higher level of wages and charges in Damour. As reported in the section on costs of producing oranges, workers are paid at the rate of LL 6 per day in Damour and LL 5 in South Lebanon.

COSTS AND RETURNS FROM BANANAS PLANTED AMONG YOUNG ORANGE TREES

It is common practice to interplant bananas among citrus trees to use the land between the rows of young trees productively and obtain some income from the orchard during the seven years before receipts from the sale of oranges are sufficient to cover the annual care-costs of the citrus trees. Bananas provide income during the first year of planting, though the yield is less than that of established trees. From the second through the seventh years of developing an orange orchard, the interplanted bananas provide from LL 122 to LL 363 net returns above their production costs. This income was applied toward the expenses of caring for the young orange trees as shown in Tables 12 and 13. The costs of growing the interplanted bananas and the returns from the fruit harvested each year are shown in Tables 14 and 15. Yields were calculated on the dunum basis because in bananas one "mat" (rhizome from which the suckers grow) may produce more than one crop per year. Cropping over-laps in banana plants and the yield is influenced by climatic conditions following bloom.

Costs charged against bananas interplanted among the young orange trees in a developing orchard are only those specific to these banana plants. Original sucker plants used to start the new planting were charged at LL 1 each. Animual manure was charged at LL 1.83 per banana tree in Damour and LL 1.61 in South Lebanon, these being the average figures reported by farmers who supplied these cost data. Inorganic fertilizer was charged at 69 piasters per tree in both areas. Half of the total cost of irrigation water per dunum was charged to the bananas while the other half was applied to the costs for the young orange trees. As explained earlier, two-thirds of the cost of the salary for the the guard was allso charged against the bananas because they produce revenue with which to pay this expense.

The total cost of producing bananas interplanted among young citrus trees is nearly in proportion to the number of banana trees in production each year. This proportion occurs because most of the costs are incurred on a per tree basis. The cost tables also show that the number of trees decreases after the second year as the young citrus trees increase

in size and the nearby banana trees are removed when they begin to crowd the orange trees.

Net returns from the interplanted bananas average slightly higher per year in Damour than in South Lebanon. These higher returns are due to farmers in Damour growing about five more banana trees per dunum and achieving approximately 2 percent greater yield per tree. The higher yield is attributed to a more favorable climate combined with better care of the plantations by the small producers in Damour.

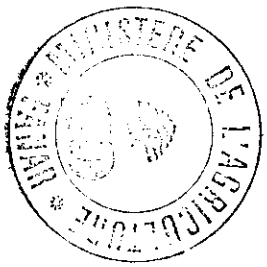


TABLE 14

ADDITIONAL COSTS FOR PRODUCING BANANAS WHEN PLANTED AMONG YOUNG ORANGE TREES IN DAMOUR AREA, 1962-1963, FIVE ORCHARDS OF 15-20 DUNUMS

	Annual Costs in Lebanese Pounds per Dunum						
	1st Year	2nd Year	3re Year	4th Year	5th Year	6th Year	7th Year
Number of Banana Trees per Dunum	70	110	101	96	81	60	50
Materials							
Sucker plants	70.00	..	..	..	..	..	..
Animal manure	128.00	201.30	184.80	175.70	148.20	109.80	91.50
Chemical fertilizer	48.30	75.90	69.70	66.20	55.90	41.40	34.50
Irrigation water (50% of the total)	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Sand for around trees	51.80	29.60	..	..	..	..	..
Supports for stems of bananas	1.40	2.20	2.00	1.90	1.60	1.20	1.00
Total cost of materials	305.50	315.00	262.50	249.80	211.70	158.40	133.00
Labor for cultural operations							
Layout and planting trees	70.00	..	..	..	..	..	..
Spreading fertilizer	7.60	12.50	11.20	11.20	10.70	10.20	9.70
Irrigating the trees	8.50	9.50	9.00	8.50	7.50	6.50	5.50
Cultivating banana trees	55.00	53.00	48.00	45.50	43.00	42.00	40.00
Weeding banana trees	7.90	7.90	7.90	7.90	7.90	7.90	7.90
Spreading sand around trees	4.20	2.40	..	..	..	..	..
Removing dead leaves	5.60	8.80	8.10	7.60	6.50	4.80	4.00
Removing stubs of banana trees	..	8.80	8.10	7.60	6.50	4.80	4.00
Supervision and guarding (2/3)	27.00	27.00	27.00	27.00	27.00	27.00	27.00
Total cost of labor	187.20	132.10	121.30	117.20	110.70	104.40	99.10
Total cost of cultural operations	492.70	447.10	383.80	367.00	322.40	262.80	232.10
Interest on operating capital at 8% for 6 months[a]	19.47	17.64	15.11	14.44	12.66	10.27	9.04
Total cost of fruit on the trees	512.17	464.74	398.91	381.44	335.06	273.07	241.14
Harvesting							
Cutting the banana stems	0.70	2.00	2.10	2.00	1.70	1.20	1.00
Hauling to the nearest road	3.60	10.90	11.60	11.00	9.30	6.60	5.80
Total cost of harvesting	4.30	12.90	13.70	13.00	11.00	7.80	6.80
Total cost of production[b]	516.47	477.14	412.61	394.44	346.06	280.87	247.94
Production, kgs. per dunum	630	1,815	1,939	1,843	1,555	1,152	960
Value of production at 40 pts. per kg.	252.00	726.00	775.60	737.20	622.00	460.80	384.00
Net income above costs	−264.47	+248.86	+362.99	+342.76	+275.94	+179.93	+136.06

a Payment of expenses is spread over the year so interest is charged on half of the total for the year.

b Annual fixed costs are charged against the orange orchard development costs.

TABLE 15

ADDITIONAL COSTS FOR PRODUCING BANANAS WHEN PLANTED AMONG YOUNG ORANGE TREES IN SOUTH LEBANON, 1962-1963, 190 ORCHARDS OF 27 TO 35 DUNUMS

	Annual Costs in Lebanese Pounds per Dunum						
	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year
Number of Banana Trees per Dunum	64	105	96	91	76	58	47
Materials							
Sucker plants	64.00	..	..	..	..	..	..
Animal manure	105.20	192.10	154.60	146.50	122.40	93.40	75.70
Chemical fertilizer	44.20	72.40	66.20	62.80	52.40	40.00	32.40
Irrigation water (50% of total)	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Sand for around trees	60.50	37.80	..	..	..	..	..
Supports for banana stems	.60	1.05	1.00	1.00	.80	.60	.50
Total cost of materials	280.50	309.35	227.80	216.30	181.60	140.00	114.60
Labor for cultural operations							
Layout and planting 64 trees	64.00	..	..	..	..	..	..
Spreading fertilizer	6.20	12.30	10.40	10.40	8.90	8.00	8.00
Irrigating trees	5.00	5.00	5.00	5.00	4.50	4.50	4.40
Cultivating banana trees	61.70	56.00	54.50	53.00	52.00	52.00	52.00
Weeding banana trees	7.50	7.50	7.50	7.50	7.50	7.50	7.50
Spreading sand around trees	3.50	2.20	..	..	..	..	..
Propping banana stems	.85	1.05	.95	.90	.80	.60	.50
Removing dead leaves	3.50	5.80	5.30	5.00	4.20	3.20	2.60
Removing stubs of banana trees	.00	8.40	7.50	7.70	7.30	6.10	4.60
Supervision and guarding (2/3)	24.00	24.00	24.00	24.00	24.00	24.00	24.00
Total cost of Labor	176.05	122.25	115.15	113.40	109.20	105.90	103.70
Total cost of cultural operations	456.55	431.60	342.95	329.70	290.80	245.90	218.30
Interest on operating capital at 8% for 6 months[a]	18.26	17.26	13.72	13.19	11.63	9.84	8.73
Total cost of fruits on tree	474.81	448.86	356.67	342.89	302.43	255.74	227.03
Cutting of bananas LL 1 per ton	.50	1.70	1.80	1.70	1.50	1.10	.90
Hauling to the nearest road at LL 3 per ton	1.60	5.20	5.50	5.20	4.40	3.30	3.70
Total cost of harvesting	2.10	6.90	7.30	6.90	5.90	4.40	4.60
Total cost of production[b]	476.91	455.76	363.97	349.79	308.33	260.14	231.63
Production, kg. per dunum	544	1,732	1,843	1,747	1,459	1,114	902
Value of production at 40 pts. per kg.	217.60	692.80	737.20	698.80	583.60	445.60	360.80
Net income above costs	−259.31	+237.04	+373.23	+349.01	+275.27	+185.46	+129.17

a Payment of expenses is spread over the year so interest is charged on half of the total for the year.

b Annual fixed cost are charged against the orange orchard development costs.

COST AND RETURNS FROM PRODUCING BANANAS

Since bananas and citrus fruits can be grown in the same areas of land along the coast of Lebanon, producers are interested in comparison of net returns from bananas and oranges. To make such a comparison, the net returns from growing bananas were determined in the same way that those for oranges were reported in a foregoing section of this publication.

According to cost figures supplied by growers of bananas in Damour and in South Lebanon, the 1963 average annual costs for growing a dunum of bananas were found to be LL 1,084 in the Damour area and LL 918 in South Lebanon. The costs for these two areas are itemized in Tables 16 and 17 respectively.

The total annual production expenses per dunum of bananas were relatively stable because annual fixed costs constituted from 37 to 44 percent of the total costs, and the cost of cultural operations changed but little from year to year. Consequently, each producer's cost of producing a kilogram of bananas is determined to a large degree by the amount of fruit he is able to harvest from his plantation. This fact is clearly indicated in Table 18 which shows the figures of costs for three typical levels of yield; low, medium, and high. The cost per kilogram from low to high yield in Damour ranged from 51.4 to 35 piasters, while in South Lebanon it was from 46 to 32 piasters. A producer in Damour who had an average harvest of 2,600 kilograms of bananas produced them at a cost of 41.7 piasters. In South Lebanon it cost the farmer who achieved an average yield of 2,450 kilograms, 37.5 piasters per kilogram harvested. When the price at the plantation was 40 piasters, producers at Damour had to secure yield a of 2,700 kilograms per dunum in order to break even on the total costs whereas those in South Lebanon needed a harvest of 2,300 kilograms per dunum to cover their total annual production expenses.

Return on investment in Land

Producers can continue in production if they cover their out-of-pocket expenses and annual depreciation charges even though they do not obtain a return on their investment in land and improvements as

great as the rate of interest charged by banks. Therefore, returns to land were calculated for producers in both Damour and South Lebanon. When the price of bananas was 40 piasters per kilogram to the producer, growers in Damour achieving an average yield of 2,600 kilograms per dunun netted a return of 5.3 percent on their investment in land and improvements. Similarly, growers in South Lebanon obtaining an average yield of 2,450 kilograms realized a return of 7.5 percent on the value of their land. The return to other producers varied in proportion to the yield they obtained per dunum. This return also included returns to management which are difficult to identify separately.

Production costs per dunum

The costs of producing a dunum of bananas in Damour area are reported in Table 16 and those obtained from farmers in South Lebanon are listed in Table 17. The average of the total annual costs reported by growers interviewed in Damour area was LL 1,084 while for South Lebanon it was LL 918. Costs were higher for Damour producers in the three major categories of labor, production materials, and annual fixed charges for depreciation and interest. The higher labor bill for Damour producers was found to be due to their having paid LL 5.50 per day for workers compared with LL 5 in South Lebanon. Due to their maintaining 135 trees per dunum compared with 130 in South Lebanon, Damour producers required larger quantities of production materials. The Damour growers' substantially higher annual fixed costs stemmed from their land and improvements being valued at LL 6,427 per dunum compared with LL 4,090 in South Lebanon.

One practice which may have contributed to the higher average yields reported by growers in Damour region is the larger number of times they irrigated their banana trees. They applied 15 irrigations per year compared with but 12 in South Lebanon. Water is paid for at a flat annual charge per year and the only increase in expense for additional irrigations is the additional labor required. Since this expense amounted to but LL 3 per dunum, it required but a slight increase in the weight of the bananas harvested per tree to yield a profit on this payment for the extra labor employed by Damour producers when irrigating their banana trees the additional three times per season.

The annual fixed costs for a dunum of banana plantation in Damour

TABLE 16

COST PER DUNUM OF PRODUCING BANANAS ALONE, DAMOUR, 1963
10 ORCHARDS OF 15-20 DUNUMS, 135 TREES PER DUNUM

Annual Cultural Operations	Labor	Materials		Total cost of Each Operation	
		Kind	Cost	Per Dunum	Percent
	Lebanese pounds		Lebanese pounds	Lebanese pounds	
Fertilizing	16.20	Fertilizers		356.30	32.88
Spreading manure at 27 pts. per bag		Manure, 1/3 bag goat manure per tree at LL 5.50 per bag	247.00		
3 applications of chemical fertilizer		Chemical fertilizer, 3 kgs. complete fertilizer at 23 pts. per kg.	93.10		
1 girl at LL 1.38 per du. per time					
Cultivations (4) : 4 men per du. per cultivation at LL 5.50 per man	88.00		..	88.00	8.12
Weeding : 2 by 1/2 man at LL 5.50 and 1/2 girl at LL 2.75 per du. per time	8.20		..	8.20	0.76
Irrigating					
15 at LL 1.10 per du. per irrigation	16.50	Water cost	10.90		
Cleaning canals, 1/2 man per du. at LL 5.50	2.80			29.30	2.70
Removing leaves: 3 times, 1 girl at LL 2.75 per du. per time	8.30		..	8.30	0.77
Removing stubs : 2 men per du. at LL5.50	11.00		..	11.00	1.02
Repairs to irrigation facilities, fences, terraces, roads, and tools	2.90	Cement, sand, stone, metal parts, wood, etc.	3.00	5.90	0.54
Maintenance of windbreaks	1.00		..	1.00	0.09
Guarding and supervision : 1 man at LL 150.00 per month for 45 du.	40.00		..	40.00	3.70
Miscellaneous labor costs	11.50		..	11.50	1.06
Placing props under stems of bananas	2.50	Supports for stems of banana	2.90	5.40	0.50
Total cost of cultural operations	208.90		256.00	564.90	52.14
Interest on wages paid at 8% for 6 months	8.36	Interest on cost of materials at 8% for 6 months	14.24	22.60	2.08
Total on-tree costs	217.26		370.24	587.50	54.22
Harvesting					
Cutting bunches at LL 10 per ton	2.86				
Gathering bunches, and hauling to the nearest road at LL 6.00 per ton (2600 kg)	15.60		..	18.46	1.71
Total cash costs	235.72		370.24	605.96	55.93
Annual fixed costs[a]					
Depreciation of :					
Irrigation facilities, sanding, fences, windbreaks, and hand tools				15.20	1.40
1 year old developed orchard costing (LL 755.11 at 5%) (20 years productive life) [b]				37.76	3.48
Interest on :					
Investment in developed land, terraces, roads, improvements, (LL 6,427 at 6%)				385.62	35.59
Half of the cost of sanding, irrigation facilities, fences, windbreaks, and hand tools				8.76	0.81
Half of the cost of developing the bearing orchard, (LL 377.56, at 8%)				30.20	2.79
Total annual fixed costs				477.54	44.07
Total cost (excluding management) of the harvest delivered to the nearest road				1,083.50	100.00

a See Table 11 for calculations. Half of original cost represents the average investment during the life of the assets.

b See Table 19 for statement of costs.

TABLE 17

COST PER DUNUM OF PRODUCING BANANAS ALONE IN SOUTH LEBANON, 1963
20 ORCHARDS OF 27-35 DUNUM, 130 TREES PER DUNUM

Annual Cultural Operaiions	Labor	Materials		Total Cost of Each Operation	
		Kind	Cost	Per Dunum	Percent
	Lebanese Pounds		Lebanese Pounds	Lebanese Pounds	
Fertilizing	14.60	Fertilizers		342.20	37.29
1 manure spreading at 25 pts. per bag		Manure: 1/3 bag per tree annually at average price of LL 5.50 per bag or LL 1.83 per tree	237.90		
3 applications of chemical fertilizer 1 girl at LL 1.25 per du. per application		Chemical fertilizer: 2 kgs. 10-6-10 mixed fertilizer per tree at 21 pts. per kg. 1 kg. ammonium sulfate per tree at 18 pts. per kg. 1/2 kg. ammonium sulfate per tree at 18 pts. per kg.	89.70		
Irrigation: av. of 12 at LL 1.00 per irrigation	12.00	Average of water cost from Kasmieh canal and pumped water	12.00	26.50	2.88
Cleaning canals, 1/2 man at LL 5.00 per du.	2.50				
Cultivations (4 1/2): av. of 4 men at LL 5.00 per du. per cultivation	90.00		..	90.00	9.81
Weeding (2): 1 1/2 girls at LL 2.50 per du. per time	7.50		..	7.50	0.82
Removing leaves (3): 1 girl at LL 2.50 per du. per time	7.50		..	7.50	0.82
Removing stubs: 2 men at LL 5.00 per du.	10.00		..	10.00	1.09
Propping: 1 man at LL 5.00 per 3 du.	1.70	Supports: 45 at 10 pts. each, every 3 years	1.50	3.20	0.35
at LL 5.00 per du.	2.50		..	2.50	0.27
Guarding and supervision: 1 man at LL 150.00 per month per 50 du.	36.00		..	36.00	3.92
Repairs to building, irrigation facilities roads, terraces, fences, and tools	4.30	Cement, sand, stone, metal parts, wood, etc.	4.60	8.90	0.97
Miscellaneous labor costs	12.00		..	12.00	1.31
Total costs of cultural operations	200.60		345.70	546.30	59.53
Interest on wages paid at 8% for 6 months	8.02	Interest on cost material at 8% for 6 months	13.83	21.85	2.38
Total on-tree costs	208.62		359.53	568.15	61.91
Harvesting					
Cutting bunches at LL 1.00 per ton (2,450 kg.)	2.45		..	9.80	1.07
Gathering bunches and hauling to the nearest road at LL 3.00 per ton (2,450 kg.)	7.35		..	..	..
Total cash costs	218.42		359.53	577.95	62.98
Annual fixed costs[a]					
Depreciation of:					
Sanding, buildings, irrigation facilities, fences, windbreaks, and hand tools				23.20	2.53
1 year old developed orchard costing (LL 626.96 at 5%) (20 years productive life)[b]				31.35	3.42
Interest on:					
Investment in developed land, terraces, roads, and improvements (LL 4,090 at 6%)				245.40	26.74
Half of the cost of buildings, irrigation facilities, sanding, fences, windbreaks, and hand tools				14.72	1.60
Half of the cost of developing the full bearing orchard, (LL 313.48 at 8%)				25.08	2.73
Total annual fixed costs				339.75	37.02
Total costs (excluding management) of the harvest delivered to the nearest road				917.70	100.00

a See Table 11 for calculations. Half of the original cost represents the average investment during the life of the assets.
b See Table 20 for statement of costs.

were found to be 40 percent higher than those reported in South Lebanon. In addition to the interest on the investment in land in Damour being more than 50 percent greater than in South Lebanon, the depreciation charge on the cost of the developed banana plantation and the interest on the investment in bearing trees is also materially larger. This larger cost is due to the greater expense of caring for a dunum of bananas resulting from higher wages for workers and the larger number of trees planted per dunum.

TABLE 18

COST PER KILOGRAM OF PRODUCING BANANAS IN DAMOUR AND SOUTH LEBANON

	Damour			South Lebanon		
	Cost of Growing a Dunum LL 1,084			Cost of Growing a Dunum LL 918		
	Piasters Per Kilogram			Piasters Per Kilogram		
If the yield per dunum is:	2,100 kg.	2,600 kg.	3,100 kg.	2,000 kg.	2,450 kg.	2,900 kg.
Total on-the-tree costs amount to:	27.98	22.60	18.95	28.41	23.19	19.59
Costs of harvesting and hauling to the road are:	0.71	0.71	0.71	0.40	0.40	0.40
Annual fixed costs amount to:	22.74	18.37	15.40	16.99	13.87	11.72
Total costs amount to:	51.43	41.68	35.06	45.80	37.46	31.71
Total costs, except interest on land and improvements (management omitted)	33.23	26.84	22.51	33.60	27.43	23.17
Return to land and management at 40 pts. per kg. of bananas	+6.77	+13.16	+17.49	+6.40	+12.57	+16.83
Return Per Dunum of Land when the Producer Receives 40 Piasters Per Kilogram of Bananas						
Amount of return per du.	LL 142.17	LL 342.16	LL 542.19	LL 128.00	LL 307.97	LL 488.07
Percentage return on the investment in land and improvements	2.21	5.32	8.44	3.13	7.53	11.93

COST PER DUNUM OF ESTABLISHING A BANANA PLANTATION

The cost of establishing a dunum of bananas is much less than that for oranges because banana trees reach more than 80 percent production during the second year and are in full production the third year. By comparison orange trees generally do not produce sufficient fruit to cover annual care-costs until the eighth year. Returns from the sale of the bananas exceed expenses during the second year after setting out suckers. The costs of planting a dunum of banana plants and caring for them during the first year, as shown in Table 19 and 20, was reported by growers in Damour and South Lebanon, respectively. The itemizing of investment in land, improvements, terraces, irrigation facilities, fences and windbreaks, and hand tools is given in Table 11. The additionnal investment required initially when preparing land for planting with bananas, as compared to the investment for citrus tree planting, was the application and incorporation of about 5 centimeters of sand into clay soil. The purpose of adding the sand is to improve soil texture, so as to provide for better plant growth. According to the figures supplied by growers, sanding costs an average of LL 120 per dunum in South Lebanon compared with LL 100 in Damour.

The higher cost of materials for planting a dunum of bananas in Damour is due to setting 135 suckers per dunum compared with 130 in South Lebanon, and also to spending 22 piasters more per tree for animal manure. Most cultural operations cost more in Damour because of the higher wages paid. Operations contracted on a per tree basis cost correspondingly more in Damour. The only cultural operation for which growers in South Lebanon pay more is that of cultivating the plants during the first year.

Growers of bananas in South Lebanon have higher expenses for depreciation of their facilities and greater interest on the costs of these facilities because they have buildings in their groves for storage purposes. Such buildings are not used in Damour. Total annual fixed costs in South Lebanon are only 70 percent of those in Damour due to the substantially lower value of land in South.

Establishing bananas

The number of kilograms of bananas harvested the first year in South Lebanon was about 10 percent less than in Damour. Thus, net cost of bringing a dunum of bananas to profitable bearing age at the end of a plantation's first year is only 83 percent of the average cost reported by Damour growers. The net cost of a dunum of profitable bearing banana trees in Damour was reported to average LL 755 and LL 627 in South Lebanon. Thus, producers in the south have substantially lower annual fixed costs for depreciation and interest in banana production as the result of the lower cost of bringing trees to nearly full bearing size. The annual saving in depreciation and interest on the cost of the bearing trees amounted to 17 percent, while the saving of interest due to the substantially lower value of land amounted to an additional saving of 37 percent. The lower fixed costs for producers in South Lebanon provided them with a return of over 7 percent in the investment in their banana plantation when yields averaged 2,450 kilograms per dunum and the price was 40 piasters. Growers who attained an average harvest of 2,600 kilograms per dunum in Damour netted 5.3 percent on their invested capital at the same selling price.

Points of Cost - Price Equilibrium And Equal Returns

Market prices for oranges and bananas vary from day to day and from year to year. Producers who wish to determine whether a profit can be made by selling their fruit at the price offered by a contractor, a packer, or a wholesaler need to know what it costs them per kilogram to produce the crop. As pointed out previously, the cost per kilogram is determined by the costs of caring for a dunum of banana plantation or of an orange grove during the crop year plus the annual fixed costs in relation to the number of kilograms of fruit harvested. These calculations are shown for oranges in Table 8, for bananas in Table 18.

Points of Cost - Price Equilibrium

Cost - price equilibrium is the point at which the price equals the cost of production per kilogram. Since the costs for growing a dunum of bananas or of oranges do not vary as much as the yields, the cost of production per kilogram is determined primarily by the yield which the producer obtains as the result of his management and cultural practices. Assuming that the averages of medium yields per dunum reported by the growers interviewed in this study are typical and that their costs per

TABLE 19

COST OF ESTABLISHING A DUNUM OF BANANA ORCHARD IN DAMOUR, 1963
135 TREES PER DUNUM. BASED ON DATA FOR FIVE ORCHARDS OF 15-20 DUNUMS

Total initial investment[a]			LL 6,671.00
Materials	Per Tree	Lebanese Pounds	
Sucker plants	LL 1.00	135.00	
Animal manure	1.83	247.05	
Chemical fertilizer	.69	93.15	
Irrigation Water	—	10.00	
Supports for banana stems	.02	2.70	
Total cost of materials			487.90
Labor for cultural operations			
Layout and planting trees	1.00	135.00	
Spreading fertilizer	.11	14.85	
Irrigating trees	.09	12.15	
Cleaning irrigation canals	—	2.80	
Cultivation	.47	63.45	
Weeding	.08	10.80	
Propping banana stems	.02	2.70	
Removing dead leaves	.08	10.80	
Removing stubs of banana trees	.08	10.80	
Supervision and guarding	—	40.00	
Total cost of labor			303.35
Total cost of cultural operations			791.25
Interest on half of cultural costs at 8%			31.65
Total cost of fruit on the trees			822.90
Harvesting (av. 9 kgs. per tree)			
Cutting the banana stems at LL 1.10 per ton		1.34	
Hauling to the nearest road at LL 6.00 per ton		7.29	
Total cost of harvesting			8.63
Total cash costs			831.53
Annual fixed costs[b]			
Depreciation of:			
Sanding, irrigation facilities, fences, windbreaks, and hand tools		15.20	
Interest on:			
Investment in developed land, terraces, roads, and improvements (LL 6,427 at 6%)		385.62	
Half of cost of sanding facilities, fences, windbreaks, and hand tools		8.76	
Total annual fixed costs			409.58
Total costs of planting and caring for a du. of banana orchard			1,241.11
Credit for returns from sale of the harvested crop of 1,215 kgs. of bananas sold at 40 pts. per kg.			486.00
Net cost of one du. of bearing banana trees one year old			755.11

a See Table 11 for itemization.
b See Table 11 for calculation of depreciation and interest.

TABLE 20

COST OF ESTABLISHING A DUNUM OF BANANA ORCHARD IN SOUTH LEBANON, 1963
130 TREES PER DUNUM, BASED ON DATA FOR 19 ORCHARDS OF 27-35 DUNUMS

Total initial investment[a]			LL 4,488.00
Materials	Per Tree	Lebanese Pounds	
Sucker	LL 1.00	130.00	
Animal manure	1.61	209.30	
Chemical fertilizer	.69	89.70	
Irrigation water	—	12.00	
Supports for banana stems	.01	1.30	
Total cost of materials			442.30
Labor for cultural operations			
Layout and planting trees	1.00	130.00	
Spreading fertilizer	.10	13.00	
Cleaning irrigation canals	—	2.50	
Irrigating trees	.09	12.00	
Cultivation	.69	90.00	
Weeding	.06	7.50	
Propping stems of bananas	.01	1.30	
Removing dead leaves	.06	7.15	
Removing stubs of banana trees	.08	10.40	
Supervision and guarding	—	35.00	
Total cost of labor			308.85
Total cost of cultural operations			751.15
Interest on half of cultural costs at 8%			30.05
Total cost of fruit on the trees			781.20
Harvesting (av. 8.5 kgs. per tree)			
Cutting the bananas stems at LL 11.00 per ton		1.11	
Hauling to the nearest road at LL 3.00 per ton		3.33	
Total cost of harvesting			4.44
Total cash costs			785.64
Annual fixed costs[b]			
Depreciation of sanding, irrigation facilities, buildings, fences windbreaks, and hand tools.		23.20	
Interest on:			
Investment in developed land, terraces, roads, and improvements		245.40	
Half of cost of sanding, irrigation facilities, buildings, fences, windbreaks, and hand tools		14.72	
Total annual fixed costs			283.32
Total costs of planting and caring for a du. of banana orchard			1,068.96
Credit for returns from sale of the harvested crop of 1105 kgs. of bananas sold at 40 pts. per kg.			442.00
Net cost of one du. of bearing banana trees one year old			626.96

a See Table 11 for itemization.
b See Table 11 for calculation of depreciation and interest.

dunum are representative for the Damour and South Lebanon areas, the price that equals the cost of producing oranges and bananas in each of these areas is as follows :

Bananas	Damour	South Lebanon
Production cost per dunum	LL 1,083.50	LL 917.70
Average medium yield	2,600 kgs.	2,450 kgs.
Price equal to cost	41.7 pts.	37.5 pts.
Oranges	**Damour**	**South Lebanon**
Production cost per dunum	LL 1,010.67	LL 817.65
Average medium yield	3,400 kgs.	3,100 kgs.
Price equal to cost	29.6 pts.	26.6 pts.

These are the prices which farmers having the above mentioned total costs, including interest of 6 percent on the value of their land and improvements, need to obtain in order to cover these costs and avoid a loss. If they can sell for prices higher than these, they can make profits and returns to management.

It was the concensus of producers interviewed that 20 piasters and 40 piasters were typical prices for oranges and bananas respectively. Therefore, another equilibrium point of importance is the yield at which cost of production per kilogram equals the foregoing prices. Such yields are given below :

Bananas	Damour	South Lebanon
Production cost per dunum	LL 1,083.50	LL 917.70
Typical price	40 pts.	40 pts.
Yield needed for cost to equal price	2,709 kgs.	2,295 kgs.
Average medium yield	2,600 kgs.	2,450 kgs.
Average high yield	3,100 kgs.	2,900 kgs.
Oranges		
Production cost per dunum	LL 1,010.67	LL 817.65
Typical price	20 pts.	20 pts.
Yield needed for cost to equal price	5,053 kgs.	4,088 kgs.
Average medium yield	3,400 kgs.	3,100 kgs.
Average high yield	3,900 kgs.	3,600 kgs.

The above tabulation shows that the majority of producers of bananas in South Lebanon are obtaining yields above the point of cost - price equilibrium. In the Damour area, producers must achieve relatively high yields to reach the point of cost - price equilibrium, when the price is typical. The yield of oranges at which the cost per kilogram equals the typical price is far above what are regarded as high yields for both areas. Since yields in others countries rarely exceed 4,000 kilograms per dunum, it is doubtful whether it would be possible to obtain sufficient yield for the cost per kilogram to equal the typical price received by producers in Damour area. Because the cost of production per dunum is 20 percent higher than in South Lebanon, it will be necessary for Damour producers to find ways to reduce their costs substantially in order that prices will cover the costs of growing oranges on their high priced land.

Equal Returns From Bananas and Oranges

When bananas sell for the typical price of 40 piasters per kilogram and oranges are priced at 20 piasters, growers must achieve higher than current yields of oranges in Damour and South Lebanon if the percent return on the value of land planted with oranges is to equal that commonly earned by land in banana plantations. This appraisal appears in Table 21. It was shown in Table 18 that when bananas are bringing producers 40 piasters per kilogram and average medium yields are harvested, the return on the investment in land and improvements was 5.3 percent and 7.5 percent in Damour and South Lebanon respectively. If similar land is growing oranges and average medium yields are harvested, the net return to land was equivalent to 0.86 percent in Damour and 1.2 percent in South Lebanon. When interest is calculated on the investment in the land at the rate of return for land growing bananas, i.e., 5.3 percent in Damour and 7.5 percent in South Lebanon, the total cost of growing a dunum of oranges would be LL 967.17 in Damour and LL 879.95 in South Lebanon. To achieve a cost - price equilibrium at these figures, Damour growers need to harvest 4,836 kilograms and South Lebanon growers 4,400 kilograms.

To realize the same rate of return on the value of their land from oranges as from bananas that are producing average medium yields sold at 40 piasters per kilogram, growers in Damour must receive 24.8 piasters per kilogram of oranges and a yield of 3,900 kilograms per dunum.

TABLE 21

COMPARISON OF COSTS AND RETURNS FOR ORANGES AND BANANAS IN DAMOUR AND SOUTH LEBANON, 1963. AVERAGE MEDIUM YIELDS

	Damour			South Lebanon		
	Kilograms	Money	Percent	Kilograms	Money	Percent
1. Receipts from an av. harvest of bananas at 40 pts. per kg.	2,600	LL 1.040.00	—	2,450	LL 980.00	—
2. Cost of growing a du. of bananas, other than interest on investment in land and improvements	(Table 16)	697.88	—	(Table 17)	672.30	—
3. Net returns on investment in land and improvements	—	342.12	—	—	307.70	—
4. Percentage which these returns are on this investment	—	—	5.3	—	—	7.5
5. Receipts from an av. harvest of oranges at 20 pts. per kg.	3,400	680.00	—	3,100	620.00	—
6. Cost of growing a du. of oranges, other than investment in land and improvements	(Table 9)	625.05	—	(Table 10)	572.25	—
7. Net returns to land and improvements from sale of oranges	—	54.95	—	—	47.75	—
8. Percentage which these returns are to value of land and improvements	—	—	0.9	—	—	1.2
9. Cost of growing a du. of oranges, including interest on the investment in land and improvements at the rates of interest stated in No.4 above	—	LL 967.17	—	—	LL 879.95	—
10. Price per kg. of oranges which produces the amount of money shown in No.9 when avrerage yields are:	3,400 3,900	28.5 pts. 24.8 pts.	— —	3.100 3,600	28.4 pts. 24.4 pts.	— —
11. Yield per du. of oranges which produces the amount of money shown in No. 9 when oranges are sold at 20 pts. per kg.	4,836			4,400		

For producers in South Lebanon, a price of 24.4 piasters per kilogram of oranges and a yield of 3,600 kilograms per dunum would provide the same rate of return on the value of land as that from bananas. Thus, oranges must bring growers with high yields 24-25 piasters per kilogram in order for returns on their investment in land to equal those from growing bananas at prevailing prices and average yields.

Equally Profitable Prices

Since both bananas and oranges can be grown in many areas along the coast of Lebanon, farmers who have suitable land for establishing a new banana plantation or a new orange orchard are concerned with the relative returns to be anticipated from these two alternative fruits. As has been demonstrated earlier in this report, net returns depend not only upon the selling price of the fruit and the cost of producing a crop, but also the yield. Thus, in order to determine what prices of bananas and oranges are equally profitable, it is necessary to have estimates of the cost of producing a dunum of each fruit and the yield of each it is expected to attain.

In order to facilitate determining what prices of bananas and oranges are equally profitable in Damour and South Lebanon when the cost of production of each is that shown in Table 9, 10, 16 and 17, data for the comparable prices of these two fruits at three different levels of yields are given in Tables 22 and 23. If the expected yield from a dunum of oranges is 3,400 kilograms in Damour and the anticipated price is 20 piastres per kilogram, while the expected yield of bananas is 2,600 kilograms, then bananas would have to sell for 29 piasters per kilogram for the two fruits to be equally profitable. Table 23 shows that with per dunum yields of 3,100 kilograms of oranges and 2,450 kilograms of bananas in South Lebanon, a price of 25 piasters per kilogram of oranges is equally profitable with 36 piasters per kilogram for bananas.

TABLE 22

PRICES FOR ORANGES AND BANANAS IN DAMOUR WHICH ARE EQUALLY PROFITABLE

Orange Yields												
	2900 Kgs. Per Dunum				3400 Kgs. Per Dunum				3900 Kgs. Per Dunum			
	Prices of Oranges Received by Producers											
	Piasters Per Kilogram				Piasters Per Kilogram				Piasters Per Kilogram			
	15	20	25	30	15	20	25	30	15	20	25	30
Banana Yields	Prices of bananas which are Equally Profitable											
2100 kgs. per du.	25	31	38	45	28	36	44	52	31	40	50	59
2600 kgs. per du.	20	26	31	37	23	29	36	42	25	33	40	48
3100 kgs. per du.	17	22	26	31	19	25	30	35	21	28	34	40

The equally profitable price for bananas, or any other crop, can be calculated by using the following formula:

$$P_B = \frac{(P_A \times Y_A) - C_A \div C_B}{Y_B}$$

where: P_A = Expected price of crop A

Y_A = Expected yield of crop A

C_A = Cost of production per kilogram of crop A

P_B = Equally profitable price of crop B

Y_B = Expected yield of crop B

C_B = Cost of production per kilogram of crop B

TABLE 23

PRICES FOR ORANGES AND BANANAS IN SOUTH LEBANON WHICH ARE EQUALLY PROFITABLE

Orange Yields												
	2600 Kgs. Per Dunum				3100 Kgs. Per Dunum				3600 Kgs. Per Dunum			
	Prices of Oranges Received by Producers											
	Piasters Per Kilogram				Piasters Per Kilogram				Piasters Per Kilogram			
	15	20	25	30	15	20	25	30	15	20	25	30
Banana Yields	Prices of Bananas which are Equally Profitable											
2000 kgs. per du.	25	32	38	45	29	36	44	52	32	41	50	59
2450 kgs. per du.	21	26	31	37	23	30	36	42	26	34	41	48
2900 kgs. per du.	18	22	27	30	20	25	31	36	22	29	35	41

The equally profitable price for bananas, or any other crop, can be calculated by using the following formula:

$$P_B = \frac{(P_A \times Y_A) - C_A \div C_B}{Y_B}$$

where: P_A = Expected price of crop A

Y_A = Expected yield of crop A

C_A = Cost of production per kilogram of crop A

P_B = Price of crop B (equally-profitable price).

Y_B = Expected yield of crop B

C_B = Cost of production per kilogram of crop B

COMPARATIVE COSTS IN COMPETING COUNTRIES

While producers of oranges in Lebanon have no competition from imported citrus, they do experience strong competition for their export surplus on European markets. Italy and Spain are the principal European countries producing citrus and their production is expanding, particularly in the newly irrigated areas in the south of Italy. The United States exports substantial amounts of oranges to Europe, mainly from Florida and California.

Examination of the costs of producing oranges in Italy, Spain, and the United States indicates the level of prices at which these countries are supplying the European market. To sell in European countries, Lebanese exporters must meet the prices at which oranges are offered from other sources. Thus, if Lebanese oranges are to be competitive in Europe, the cost of producing them has to be in line with costs in other countries supplying this market. Study of production costs in these countries can indicate ways in which production costs in Lebanon may be lowered.

ITALY

The situation of citrus production in Italy is summarized in the following quote from a study made by J. Henry Burke of the United States Foreign Agricultural Service and reported inn US/FAS, Report No. 59.

> Italy has the world's largest lemon industry and the largest orange production of any member of the European Community, the Common Market. It is also the most important source of blood oranges.
>
> Its orange industry is the world's fastest growing one, and the area of trees not yet in bearing may be double the bearing acreage. This explosion in citrus planting has been brought about by the extensive reclamation and land reform program in southern Italy which will bring about 600,000 acres under irrigation in the near future. Larger exports to Eastern Europe and hope for expanded sales in the Common Market are the reasons usually given for the impetus to new plantings, but the availability of newly irrigated land and the recent high prices of oranges are probably the primary motivating factors.

> In 1957, Italy had a total citrus acreage of about 169,000 acres ; in 1960, it was an estimated 300,000. Most of the increase was in oranges; acreage more than doubled. By 1970, Italy may have 400,000 acres in citrus.
>
> In that year, production could reach 50 million boxes of oranges (up from 23 million in 1959), 5 million of tangerines or mandarines (4 million in 1959), and 15 million of lemons (11 million in 1959). Italy has the potential of nearly equaling Spain's orange and California's lemon production.
>
> Citrus land is expensive (LL 3750 per dunum in 1966). Taxes are high, LL 45 to LL 53 per dunum for citrus property. Also wages are low. Men cultivating groves by hand receive LL 6 to LL 7 per day, and women packing fruit receive about LL 3 per day. Cultural care is estimated to cost from LL 205 to LL 330 per dunum per year.
>
> In 1960, the cost of producing oranges was estimated at 7 piasters per kilogram and lemons at 8 piasters. The cost of picking and hauling to the road a 35 kilogram box of citrus was estimated at 60 piasters, and packing, including all material, at LL 2.40 per box.[1]

Prices of fertilizers, spray materials, wages, irrigation water, budded trees for planting citrus orchards, and the cost of land are shown in Table 24. They indicate costs of items as experienced by growers in Italy. The prices of some items are higher than those paid by Lebanese producers while others are lower.

Since no figures could be found for the costs of producing oranges, it was necessary to use data relating to lemons. According to the previous quotation from Mr. Burke, the costs of growing oranges are slightly less than those for lemons. The costs of producing lemons in Italy reported by Dr. Carmelo Schifani in his study of lemon farms in Bagheria are given in Table 25. If the item of interest on capital invested in high priced land and in the trees brought to profitable bearing age is omitted from the calculation, the cost per kilogram amounted to 13 piasters.

[1]United States Foreign Agricultural Service, Citrus Industry sf Italy, FAS Report No. 59, March 1962, pp. 1-2., Figures converted from acres and dollars to dunums and Lebanese pounds.

TABLE 24

SOME CULTURAL COSTS FOR CITRUS IN ITALY*, 1959

Item		Unit	Cost in Lebanese Pounds
Fertilizers			
Ammonium sulfate		Per ton	319.01
Ammonium nitrate		" "	271.10
Calcium cynamid		" "	335.28
Phosphate (18-20 percent)		" "	86.23
Potassium chloride		" "	149.69
Potassium sulfate		" "	217.93
Mixed fertilizer : 0-12-12		" "	162.86
4-10-10		" "	146.09
5-15-8		" "	179.62
8-8-8		" "	165.26
Pest control materials		Per Kg.	
Spray oil	80%	" "	1.58
Parathion	50%	" "	11.95
Malathion	50%	" "	8.12
DDT	75%	" "	5.74
Dithane	65%	" "	3.10
Kelthane	20%	" "	11.48
Copper Sulfate		" "	0.73
Wages			
Field labor, men		Day	6.24–6.72
Othe items			
Citrus land not planted : Catania area		Per du.	750.00–1,125.00
Citrus grove bearing fruit		Per du.	3,750.00–5,625.00
Budded citrus tree in nursery		Each	0.72– 3.12
Irrigation water Palermo area	1,000-1,200	Cu. ft.	– 5.76
		Per du.	30.00– 47.25

* United States Foreign Agricultural Service, Citrus Industry of Italy, FAS Report No. 59, March 1962, p. 30.

TABLE 25

COST OF PRODUCING LEMONS IN ITALY, 1959*

TREES 21-65 YEARS OLD

Item	Production Costs Per Dunum	
	Lebanese Pounds	Percent
Materials costs		
Fertilizers: Organic	12.42	1.55
Mineral	40.71	5.08
Total cost of fertilizers	53.13	6.63
Irrigation water	40.71	5.08
Spraying	9.76	1.22
Transportation (estimated)	5.00	.62
Total material costs	108.60	13.55
Labor costs		
Cultivation, irrigation, spraying	61.17	7.63
Pruning	22.43	2.80
Total labor costs	83.60	10.43
Taxes	55.00	6.86
Total operating cost	247.20	30.84
Interest on half the operating capital at 8%	9.89	1.24
Total on-tree costs	257.09	32.08
Harvesting	54.37	6.78
Total cash-costs	311.46	38.86
Fixed costs		
Depreciation and repairs	40.00	4.99
Interest on investment in land and trees (LL 7500 at 6%)	450.00	56.15
Total fixed costs	490.00	61.14
Total cost per du.	801.46	100.00
Cost per kg. (yield 2,642 kgs. per du.)	30.34 pts. per kg.	
Cost per kg. omitting interest on capital	13.30 pts. per kg.	

* Carmelo Schifani, Technico - Economical Analysis of Lemon Farms in Bagheria, Italy, Istituto Nazionale Di Economia Agraria, Palermo, 1962, p. 71.

TABLE 26

ESTIMATED COST OF PRODUCTION OF LEMON IN SICILY, 1959*

Item	Production Costs Per Dunum	
	Estimate No. 1	Estimate No. 2
	Lebanese Pounds	Lebanese Pounds
Fertilizer, mineral	18.75	37.50
Fertilizer, organic	11.25	19.50
Irrigation water	30.00	47.25
Pest control	7.90	6.75
Cultural labor	63.75	99.75
General expenses	7.50	24.00
Taxes (land and other)	45.00	51.75
Improvements	3.75	4.50
Depreciation and repairs	15.00	39.00
Total operating cost	202.50	330.00
Average yield per du.	2,600 kgs.	3,100 kgs.
Cost of production per kg.	7.79 pts.	10.65 pts.
Picking and hauling	42.00	42.00
Interest on capital	12.00	12.00
Administrative costs	22.50	22.50
Total costs	279.00	406.50
Cost per kg. at the farm gate	10.07 pts.	13.11 pts.

United States Foreign Agricultural Service, Citrus Industry of Italy, FAS Report No. 59, March 1962, pp. 2, 31.

Estimates collected by Mr. Burke in Sicily indicated a range in cost per kilogram of from 10 to 13 piasters. The interest included in his calculations given in Table 26 apparently applies to the annual operating capital used to pay cultural costs rather than to investment in land and bearing trees. Mr. Burke reported that depreciation of the bearing trees and interest on the capital invested by the farmer are not serious considerations for the Italian citrus grower. "His important costs are taxes, water, labor, and fertilizer, in about that order." Since the great majority of citrus growers are small scale farmers dependent upon their farm income for supporting their families, they are sensitive to market prices in relation to their annual cultural costs. As long as prices received exceed production costs, farmers in the newly irrigated lands suitable for citrus growing can be expected to continue to plant more orange trees.

In the older citrus areas, the groves are small size, often 8 to 10 dunums. Most are on terraced hillsides and generally intercropped with vegetables and other fruit trees. The cultivation is by hand, the work done by the farmer and his family. In the new irrigated areas the land is generally level so that most cultural operations are mechanized. Thus, production costs in the newly developed citrus areas tend to be lower.

SPAIN

The major portion of western Europe's winter orange supply comes from Spain. Two-thirds of Spain's exports of oranges go to the Common Market countries and an increasing proportion is going to Eastern European countries. About 75 percent of the orange harvest is of export quality. Oranges are exported from November to June and lemons primarily during the summer months. Blood oranges constitute 42 percent of total production, Navels 26 percent, and late season non-blood oranges 8 percent of which 2 percent are Valencias. An increasing proportion of the harvest is of seedless varieties.

Since Spain has very low production costs of 15-16 piasters per kilogram including interest on the high value of bearing orange orchards which approximate that of Lebanon, her citrus fruits offer strong competition in European markets. A survey of Spain's production situation in 1960 has been summarized by J. Henry Burke of the United States Foreign Agriculture, Report No. 56.

In the past 10 years, orange production has nearly doubled in spite of the interruptions of the 1954 and 1956 freezes. The 46 million-box crop of 1959 was the largest in the past 10 years. Extensive young plantings indicate that Spain has a potential production of 50 million boxes of oranges by 1965, and 55 million boxes by 1970. This is only a potential and it is unlikely to be realized.

Three important factors must be considered in evaluating Spain's future orange-producing capacity. One is the extensive area planted to citrus that has yet to come into bearing. This indicates the potential of expanded production. Two equally important factors will limit the extent to which this potential is realized. Spain has a history of repeated frost damage. It is likely to occur again before 1965 and is almost certain by 1970. This alone is a major retarding factor. In addition, Spain now has the three-killing virus disease, tristeza. If tristeza spreads slowly, a continuing tree-replacement program will certainly have some influence on commercial production. If it spreads rapidly, it could destroy Spain's sweet orange industry within the next 15 years.

Considering all factors, the 1965 orange crop could range anywhere from 30 million to 55 million boxes. Production in 1970 could reach 55 million boxes, but there are equal grounds for estimating that it might be only 25 million boxes if tristeza is as destructive in Spain as it was in Brazil [1]

Cultural Practices

The older citrus areas of Spain are characterized by small holdings with 31 to 38 trees per dunum. Spanish farmers practice traditional Mediterranean hand methods of cultivation and wage rates are low. The soil is hand-worked to a depth of 15 centimeters in the spring and then clean-cultivation is maintained with light horse-drawn cultivators supplemented by hand hoeing. The use of small garden tractors for cultivations is increasing due to rising labor costs. Mechanized cultivation is more widely used in the newer, irrigated areas. These areas are characterized by the practice of solid plantings rather than an interculture with other fruits and vegetables.

Citrus trees in the older orchards have been heavily pruned. However, the current trend is toward moderation in pruning. Small power sprayers are used to apply oil to control scale insects with other chemicals used to control the Mediterranean fruit fly. A spray to kill aphids is also used in areas affected with tristeza disease. As much as a kilogram of nitrogen fertilizer per tree is applied in addition to animal manure. The costs of fertilizers and other production items are given in Table 27.

[1] United States Foreign Agricultural Service, Report No. 56, Revised, 1961, p. 4.

Even though the cultural practices use much man-labor, liberal applications of fertilizer and an extensive plant protection program, production costs are quite low. As summarized in Table 28, total annual cultural costs amount to about LL 140 per dunum. Picking the oranges constitutes 7 percent of the total cost per dunum compared with 11 percent for all cultural labor. Annual fixed costs are more than double the total cash expenses for care of the orchard. These costs are due to the high value of profitable bearing groves.

Cost Per Kilogram

Though annual fixed costs are high, the total annual cost for growing a dunum of oranges in Spain averages only about LL 700. With the high average yield of nearly 4,500 kilograms of orange harvesting per dunum, the total cost of production per kilogram in 1960 was but 15.5 piasters. When the fixed costs on the high price market value of profitable citrus groves are eliminated, the total cash costs averaged less than 5 piasters per kilogram for oranges ready for buyers to receive at the orchard gate.

In recent years prices to producers have been in the range of 15-20 piasters per kilogram. At such prices, orange production in Spain has been sufficiently profitable to stimulate increased plantings in suitable irrigated areas.

TABLE 27

SOME ITEMS OF CITRUS PRODUCTION COSTS, SPAIN, 1960[a]

Item	Unit	Cost Lebanese Pounds
Orange grove of bearing trees	Du.	7,300[b]
Irrigated land (suitable for citrus)	Du.	1,200
Trees		
Sweet orange	Each	1.12
Bitter orange	Each	0.95
Fertilizer		
Sulfate of amonium	Kg.	0.15
Super phosphate	Kg.	0.025
Manure, spread on the grove	Kg.	0.08
Taxes		
Valencia area	Du.	15.20
Murcia area	Du.	14.71
Digging groves, men	Per day	6.25
	Du.	24.32
Spraying	Per tree	0.60
Fumigation	Per tree	1.00
Pruning	Per Du.	9.12
Picking men	Per day	3.70
Picking women	Per day	2.50
Tractor, "Mechanical Mule"	One	2,200
Water for irrigation		
Valencia area	Du.	18.24
Murcia area	Du.	9.12

a United States Foreign Agricultural Service, Report No. 56, Revised July 1961, p. 15.
b Converted at 20 pesetas to the Lebanese pound.

TABLE 28

ESTIMATED COSTS OF PRODUCING ORANGES IN SPAIN, 1960[a]

Item	Total Costs Per Dunum	
	Lebanese Pounds[b]	Percent
Operating costs		
Cultivation	79.04	11.48
Pest control	7.42	1.08
Fertilizer	21.45	3.09
Irrigation water	21.89	3.18
Taxes	42.32	6.15
Miscellaneous	6.07	.88
Total operating costs	178.02	25.86
Interest on operating capital, (LL 178.02 at 8%) for 6 months	7.12	1.04
Total on-tree costs	185.14	26.90
Harvesting (av. yield 4,460 kgs.)		
Picking 1.13 pts. per kg.	50.40	7.32
Hauling 0.42 pts. per kg.	18.73	2.71
Total cash-costs	254.27	36.94
Fixed costs		
Depreciation on the costs of irrigations facilities, buildings, developed profitable bearing orchard (LL 6,100 at 2%)	122.00	17.73
Interest on		
Investment in developed land (LL 1,200 at 6%)	72.00	10.46
Half of the cost of buildings, irrigation facilities, developing the bearing orchard (LL 3050 at 8%)	240.00	34.87
Total annual fixed costs	434.00	63.06

Total costs per du.	688.27	100.00

Production Cost Per Kilogram with Average Yield of 4,460 Kilograms of Oranges Per Dunum

	Cost Per Kilogram
Total operating costs	3.99 pts.
Total on-tree costs	4.15 pts.
Total cash-costs	5.70 pts.
Total fixed costs	9.73 pts.
Total costs per kg.	15.43 pts.

a United States Foreign Agricultural Service, Report No. 56, Revised, July 1961, pp. 15-16.

b Converted at 20 pesatas to the Lebanese pound.

COSTS OF PRODUCING ORANGES IN THE UNITED STATES

The United States is the largest producer of oranges in the world, accounting for about one-third of the total production according to the Foreign Agricultural Service of the United States Department of Agriculture. The State of Florida alone grows about 68 percent of the total United States production and 25 percent of the world output, followed in order by California, Texas and Arizona. Production costs in these citrus growing areas are sufficiently low for oranges to be exported and sold in European markets in competition with fruit from Italy, Spain and other Mediterranean countries shipping oranges to Europe. American oranges go mainly to Belgium, Luxembourg, and Netherlands. While exports of oranges from the United States declined from an average of 2,336,000 boxes during the years 1955-1959 to 1,274,000 boxes in 1960 and 1,058,000 boxes in 1961[1], the high volume of production indicates that export will continue until these become unprofitable. With the mechanization of cultural operations, many Florida growers are producing oranges at a cost of 10 to 12 piasters per kilogram which is about half the current cost in many orchards in Lebanon. Itemization of the various costs in the four orange producing states in the United States indicates the main bases for their low cost of production.

Costs of Producing Oranges in Florida

Agricultural economists on the staff of the University of Florida have been collecting data on the costs of producing citrus in that state since 1931. The same system of data collection, analysis, and preparation of the annual report has been followed to the present. The listing of the various costs in Table 29 is somewhat different from that used in Lebanon. However, all the significant items of costs are included so that the total costs per dunum given in the table are reasonably representative for orange groves receiving proper care. Three-fourths of the groves included in the compilation of costs reported yields in the range between 2,000 and 5,125 kilograms per dunum. The Florida Citrus Mutual lists average yields for the state of Florida in the range of 2,300 to 2,700 kilograms. Thus, groves included in the tabulation probably

[1] United States Department of Agriculture, Agricultural Statistics, 1963, p. 174.

TABLE 29

COST OF PRODUCING ORANGES IN FLORIDA, 1961-1962*, PER DUNUM AND PER KILOGRAM AVERAGE COSTS FOR 142 ORCHARDS TOTALLING 14,668 DUNUMS; AVERAGE SIZE OF ORCHARDS 103 DUNUMS; AVERAGE AGE 34 YEARS; 17 TREES PER DUNUM; AVERAGE YIELD 3,450 KILOGRAMS OF ORANGES PER DUNUM

Item	Total Costs Per Dunum	
	Lebanese Pounds	Percentage
Operating costs		
Labor, power and equipment	77.93	21.08
Fertilizer materials	50.06	13.54
Spray and dust materials	27.40	7.41
State and country taxes	14.58	3.94
Miscellaneous	11.10	3.00
Total costs of cultural operations	181.07	48.97
Interest on operating capital, (LL 181.07 at 6%) for 6 months	5.43	1.43
Total on-tree costs	186.50	50.44
Picking and hauling at 3.2 pts. per kg. (3.450 kgs.)	110.40	29.86
Total cash costs	296.90	80.30
Annual fixed costs		
Depreciation of the 6 year profitable bearing orchard costing LL 775 at 2%	15.50	4.19
Interest on:		
Investment on developed land, (LL 568 at 6%)	34.08	9.22
Half of the cost of the bearing orchard, (LL 387.70 at 6%)	23.26	6.29
Total annual fixed costs	72.84	19.70
Total cost per du. without owner supervision	369.74	100%
Returns from sale of 3.450 kgs. of oranges at 17 pts. per kg.	586.50	..
Net return per du. above total costs	216.74	..

PRODUCTION COST PER KILOGRAM WITH AVERAGE YIELD OF 3,450 KILOGRAMS OF ORANGES PER DUNUM

	Cost Per Kilogram
Total cost of cultural operations	5.25 pts.
Total on-tree cost	5.41
Total cash costs for fruit delivered to packing plants	8.60
Total fixed costs	2.34
Total cost per kg.	10.94
Additional cost of protection against frost	1.00

*Based on Table 10, Thirty-One Years of Citrus Costs and Returns in Florida 1961-1962, Agricultural Extension Service, University of Florida, Gainesville, Economic Series 64-21, April 1964, p. 12.

have costs below average for the state. The United States Department of Agriculture reports the average yield for early and midseason varieties to be 2,700 kilograms per dunum and for Valencias 2,080 kilograms.

Data given in Table 29 were collected by agricultural economists of the Florida Agricultural Experiment Station from 142 groves having an average yield of 3,450 kilograms during the 1961-1962 season. These groves reported total cash costs of LL 297 per dunum and total expenses, including interest on and depreciation of the cost of the bearing trees, of LL 370 per dunum. The cost per kilogram for oranges harvested and delivered to the packing plant averaged 11 piasters.

The costs of bringing a dunum of orange trees to profitable bearing at the end of six years as shown in Table 30 amounted to LL 775. The overhead costs are included in Table 29. They were calculated from the cost of developing the orchard and the cost of land ready for planting

TABLE 30

ESTIMATED COST PER DUNUM OF BRINGING CITRUS TREES TO PROFITABLE BEARING AGE IN FLORIDA, 1962*

	Annual Costs in Lebanese Pounds Per Dunum					
	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year
Land	450.00	..	..	..	..	..
Clearing land	118.13	..	..	..	..	..
Total initial investment	568.13	..	..	..	..	..
Annual cultural operations						
Trees, 17 at LL 8.40 each	147.00	..	..	..	..	..
Setting trees	23.63	..	..	..	..	..
Watering	29.40	..	..	..	..	..
Cover crop seed	2.63	..	..	..	..	..
Labor, power, and equipment	39.90	42.21	44.52	46.83	49.14	51.45
Fertilizer materials	8.40	12.81	17.22	21.63	26.04	30.45
Spray and dust materials	0.00	0.53	1.05	2.52	3.99	5.46
State and country taxes	2.10	2.50	2.90	3.30	3.70	4.10
Miscellaneous	5.25	5.57	5.88	6.20	6.51	6.83
Total care cost	258.31	63.62	71.57	80.48	89.38	98.29
Annual fixed costs						
Interest on initial investment at 6%	34.09	34.09	34.09	34.09	34.09	34.09
Half of annual care-costs at 6%	7.75	1.91	2.15	2.41	2.68	2.95
Accumulated costs through previous year at 6%	..	18.01	25.07	33.04	39.34	43.87
Total cost for the year	300.15	117.63	132.88	150.02	165.49	179.20
Credit for oranges harvested						
kgs. per du.	..	..	..	250	500	750
Value at 18 pts. per kg.	..	..	..	45.00	90.00	135.00
Net total costs for the year	300.15	117.63	132.88	105.02	75.49	44.20
Accumulated cost at end of year	300.15	417.78	550.66	655.68	731.17	775.37

*Based on data from Florida Extension Service and Agricultural Experiment Station.

with citrus trees. Thus, overhead costs were LL 568 per dunum. The cost of a dunum of profitable bearing orange grove in Florida with an expected productive life of 50 years was LL 1,343, including the price of the land. In 1961-1962 Florida citrus grove owners reported the current market value of their orchards to the researchers. The average of these valuations was LL 1,182 per dunum. The difference between the market value and the depreciated value of the 34 year old trees plus the cost of the land amounting to LL 909 reflects the profitability of growing oranges in Florida during recent years.

In making up the tabulations of costs of growing oranges in the United States, the costs of protecting the groves from frost were omitted in order that the cost of production per kilogram would be directly comparable with costs of production in Lebanon for similar cultural operations. Actual production costs in the United States are higher than those stated in this report by the cost of frost protection. This cost includes the interest on the cost and depreciation of the oil burning heaters and the wind machines (big fans) which constitute a continuing fixed cost even though there may be no frost during the cold season. In addition, growers must bear the extra cost for fuel and labor when the equipment is operated to prevent frost damage.

Costs of Producing Oranges in Texas

Although various items of cost in Texas differ in amount from those in Florida, the total cost of producing a kilogram of oranges shown in Table 31 is virtually the same in both states for producers giving their groves good care, namely, 11 piasters per kilogram (10.82 piasters in Texas versus 10.94 piasters in Florida for groves having stated yields). Texas citrus growers must irrigate during the dry summer season whereas few Florida producers pump water to their trees when the rainfall is below normal. Ordinarily, orchards are irrigated six times during the dry season. Normal application of water is about 8 centimeters, costing LL 1.50 of the LL 7.50 listed for taxes in Table 31, LL 2.50 is water tax. This adds roughly 40 piasters to the cost of each irrigation, raising the total cost to LL 1.90. Thus, the total cost of irrigating a dunum amounts to LL 11.50.

Yields and total annual costs were about the same in both states.

TABLE 31

COST OF PRODUCING ORANGES IN TEXAS, 1962-1963[a]
MATURE GROVE OF MORE THAN 10 YEARS AGE,
29 TREES PER DUNUM, 7.5x4.5 METERS, APPROXIMATELY

Per Dunum and Per Kilogram

Annual cultural operations	Cost per Dunum Lebanese Pounds	Percent of Total Cost
Fertilizer	23.25	6.36
Spraying and dusting	50.40	13.79
Irrigation water	9.00	2.46
Irrigation labor	6.75	1.85
Making dykes around trees	5.25	1.44
Weed control and cultivation	23.25	6.36
Pruning	3.00	0.82
Replacement trees	3.00	0.82
Taxes	7.50	2.05
Total costs of cultural operations	131.40	35.95
Interest on cultural costs for 6 months at 6%	3.93	1.08
Total on-tree costs	135.22	37.03
Picking and hauling at 3.55 pts. per kg. (3,300 kgs.)	118.22	32.35
Total cash costs	253.55	69.38
Annual fixed costs		
Depreciation of bearing orchard costing LL 687.84 at 10%[b]	68.75	18.82
Interest on :		
Cost of land of LL 375 per du. at 6%	22.50	6.15
Half of the cost of the bearing orchard at 6%	20.64	5.65
Total annual fixed costs	111.92	30.62
Total cost per du.	365.47	100.00

Returns from the sale of 3,300 kgs. of oranges at 14 pts.	462.00	..
Net returns per du. above total costs	96.53	..

COST PER KILOGRAM OF ORANGES WITH AVERAGE YIELD OF 3,300 KGS. PER DUNUM

	Cost Per Kilogram
Total cost of cultural operation	3.95 pts.
Cost of harvesting and hauling to packing plant	3.55
Total cash costs for fruit delivered to packing plant	7.61
Total fixed costs	3.52
Total cost per kg.	10.83
Additional cost of protection against frost[c]	3.45

[a] Based on Table 13, Guide For Citrus Production, Texas A & M University, College Station, Texas, B-1002, December 1963, p. 50.

[b] Weather data shows 50 percent chance of a freeze killing orange trees within 10 years.

[c] See Table 40.

The lower cultural costs in Texas were offset by the much higher depreciation charge on bearing trees due to the much shorter productive life. In much of the citrus area in Texas, there is 50 percent chance that orange trees will be killed by freezing temperature within 10 years after commencing profitable bearing. Trees in Florida are rarely damaged by low temperature and have a productive life often longer than 50 years.

In Texas, the cost of bringing young orange trees to profitable bearing size at the end of six years, as shown in Table 32, was found to be LL 652 per dunum. This amount was LL 125 less per dunum than in Florida. The labor cost in Texas was lower and less fertilizer was used but more was spent in protecting the young trees from pest and diseases. Interest cost was less due to the lower price of land. Since citrus trees in Texas are planted on land which previously grew other crops, there

are no expensive improvements to be made to the land. It needs only to be deep-plowed, disced twice, and floated in order to be ready for planting the trees.

Costs[1]

Costs reported in Table 31 are those generally charged by companies which specialize in the care of citrus groves for owners who do not have a grove large enough to justify the ownership of the requisite equipment, the cost of which amounts to $ 6,210. Such companies charge LL 9 per dunum per year for supervising the cultural operations by their workers. Standard charges are made for performing the various operations, including supplying the appropriate materials.

Whether an owner can care for his grove at lower cost than the charges of the care companies depends upon his ability to lower the costs of machinery operation, labor, and supervision. The care companies are usually able to buy production supplies and materials in large quantities at as low prices as most individual grove owners. In Texas, approximately two-thirds of operating costs are for materials and taxes.

Investment in Machinery For Grove Care

According to extension farm management specialists in Texas, an owner-operator of a citrus grove needs the following equipment for performing the cultural operations in a grove.

Items	Cost Price (1963)	
	US Dollars	Lebanese Pounds
Tractor	$ 3,500	10,500
Rotary tiller	700	2,100
Light disc harrow	400	1,200
Border machine for making irrigation basins	175	525
Terracer	285	855
Dusting machine for control of insects	700	2,100
Shredder for cutting up prunings	450	1,350
Total cost of machinery	$ 6,210	LL 18,630

1 Guide for Citrus Production, Texas A & M University, College Station, Texas, B-1002, December 1963, p. 48.

TABLE 32

ESTIMATED COST PER DUNUM OF BRINGING CITRUS TREES TO PROFITABLE BEARING AGE IN TEXAS* 1963

	Annual Costs Per Dunum in Lebanese Pounds					
	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year
Total initial investment in land	375.00	..	..	..	..	..
Annual cultural operations						
Preparation of land	11.25	..	..	..	..	..
29 trees at LL 4.50	130.50	..	..	..	..	..
Planting and watering trees at 90 pts.	26.10	..	..	..	..	..
Irrigation water	52.50	9.00	9.00	9.00	9.00	9.00
Irrigation labor	..	6.75	6.75	6.75	6.75	6.75
Making dykes and trees	..	5.25	5.25	5.25	5.25	5.25
Fertilizer	1.73	3.42	5.10	9.91	14.72	14.72
Weed control and cultivation	9.38	15.38	21.38	22.32	23.25	23.25
Pruning	0.75	1.13	1.50	1.50	2.25	2.63
Basin making and maintenance	.75	..	..	..	..	..
Taxes	7.50	7.50	7.50	7.50	7.50	7.50
Spraying and dusting	..	7.95	15.45	22.95	28.13	32.49
Total annual care-costs	247.21	56.38	71.93	85.18	96.85	101.59
Interest on:						
Initial investment at 6%	22.50	22.50	22.50	22.50	22.50	22.50
Accumulated costs through previous year at 6%	..	16.63	22.46	28.71	35.27	40.06
Half of annual care costs at 6%	7.42	1.69	2.16	2.56	2.91	3.05
Total costs for the year	277.13	97.20	119.05	138.95	157.53	167.20
Credit for oranges harvested						
Kgs. per du.	..	..	106	212	555	1,050
Value at 14 pts. per kg.	..	..	14.84	29.68	77.70	147.00
Net total costs for the year	277.13	97.20	104.27	109.27	79.83	20.20
Accumulated cost at end of year	277.13	374.33	478.54	587.81	667.64	687.84

*Based on Table 13, Guide For Citrus Production, Texas A & M University, College Station, Texas, B-1002, December 1963, p. 50.

This set of machinery can take care of the cultural operations for 330 dunums of citrus orchards. The investment in machinery is equivalent to LL 55 per dunum. Owners of smaller citrus orchards find that it is cheaper to engage companies which specialize in grove-care to perform the various cultural operations with machinery for an established charge per dunum.

When it is necessary to spray citrus trees to control certain insects, a sprayer operated by the power-take-off of the tractor costs LL 900. It can spray a maximum of 200 dunums. A fully automated speed sprayer which is sufficiently powerful to spray thoroughly the trees as the machine is pulled between the rows by a tractor costs LL 21,000. Such a machine will give protection to the trees in 2,800 dunums of citrus orchard. This pulltype sprayer makes the investment equivalent to LL 7.50 per dunum compared with LL 4.50 for the power-take-off sprayer. The labor cost for spraying with the larger automated machine is so much less that the spraying cost per dunum is lower.

Costs of Producing Oranges in Arizona

The cost of producing oranges in Arizona is materially higher than in either Florida or Texas, amounting to 22 piasters per kilogram for Navels and 15 piasters for Valencias as shown in Table 33. The costs per dunum are somewhat lower, averaging from LL 314 per dunum for Navels to LL 321 for Valencias compared with LL 360 in Texas and LL 370 in Florida. The main reason for the higher cost per kilogram of fruit is the lower yield in Arizona, namely, 1,420 kilograms for Navels and 2,200 kilograms for Valencias compared with 3,330 to 3,450 kilograms in Texas and Florida, respectively.

The costs of the cultural operations are lower than in Florida due to using less chemical fertilizer and spray materials. The cost of irrigation water in Arizona is very high, amounting to LL 45 per dunum compared with LL 9 in Texas.

The calculation of the annual fixed costs per dunum based on the investment in land, improvements to land, buildings and equipment, the irrigation system and the bearing trees is shown in Table 34. Citrus groves in Arizona are developed from desert land rather than planting the trees in land that previously grew other crops as in Texas.

The cumulative cost of caring for a dunum of young orange trees five years until the return from the sale of the fruit more than covers the annual costs amounted to LL 915 in Arizona, as reported in Table 35. This amount was considerably greater than the cost of a six year old bearing orchard in Florida amounting to LL 775 and LL 687 per dunum in Texas. Items of greater cost were depreciation of buildings, equipment, irrigation system, and the considerably higher price per tree for the greater number of trees set per dunum, namely, 38 compared with 29 in Texas and 17 in Florida. The annual fixed costs per dunum are shown in Table 34.

Costs of Producing Oranges in California

Several counties in California grow substantial quantities of oranges. A study of statements of production costs and yields for orange production prepared by Extension personnel in these counties show material difference in both costs and yields. The data given in Table 36 have been synthesized from reports for the different counties in an endeavor to present representative figures for both costs and yields of the two major varieties, Navels and Valencias.

The capital investment figures shown in Table 37 were also asssembled as representative of the various citrus areas. The LL 600 per dunum price is for agricultural land growing annual crops under irrigation. Land near residential areas is valued up to LL 4,500 per dunum. Many of the groves are irrigated by wells pumping water from a depth of around 40 meters and distributed through a concrete pipe system. Low volume sprinkler systems are often used while other groves are supplied water by a government irrigation district board.

Cultural costs in California shown in Table 36 are in the range of LL 245 to LL 300 per dunum. Irrigation water, pest and disease control are major cost items. Labor cost for picking was 3.5 piasters per kilogram while picking and hauling to the packing plant cost 3.2 piasters in Florida, 3.3 piasters in Arizona, and 3.5 piasters in Texas. Annual fixed costs per dunum averaged LL 112 in California compared with LL 73 in Florida, LL 96 in Arizona, and LL 107 in Texas. These higher costs were found to be due mainly to the shorter life of the trees considered to average 25 years compared with 50 years in Arizona and Florida. The

TABLE 33

ESTIMATED COST OF PRODUCTION PER DUNUM OF NAVEL AND VALENCIA ORANGES, ARIZONA, 1963, 38 TREES PER DUNUM PLANTED 3.6 x 6.6 METERS[a]

	Navels		Valencias	
	Total Cost Per Dunum		Total Cost Per Dunum	
	Amount	Percent	Amount	Percent
Yield per dunum in kilograms	1,420	. .	2,200	. .
Annual cultural operations	Lebanese Pounds		Lebanese Pounds	
Fertilizing	21.56	6.87	19.69	6.14
Spraying	5.63	1.79	5.63	1.75
Irrigating water	45.00	14.33	45.00	14.02
Irrigating labor	9.00	2.87	9.00	2.81
Cultivating and weeding control	15.75	5.02	15.75	4.91
Pruning	16.50	5.25	0.00	0.00
Rodent control	0.75	0.24	0.75	0.23
Replant trees	2.06	0.65	2.06	0.64
Maintenance and repair	7.50	2.39	7.50	2.34
General expense	27.75	8.84	27.75	8.65
Miscellaneous	15.00	4.78	15.00	4.67
Total costs of cultural operations	166.50	53.03	148.13	46.16
Interest on operating capital at 5% for av. period of 6 months	4.16	1.32	3.70	1.15
Total on-tree costs	170.66	54.35	151.83	47.31
Picking and hauling at 3.30 pts. per kg.	46.86	14.93	72.00	22.63
Total cash costs	217.52	69.28	224.43	69.94
Annual fixed costs[b]				
Depreciation of:				
Buildings and irrigation facilities, 5 year old profitable bearing orchard costing LL 914.50 at 2%	18.75	5.97	18.75	5.84
Interest at 5% on:	18.29	5.83	18.29	5.70
Investment in developed land, LL 600	30.00	9.55	30.00	9.35
Half of the cost of buildings, irrigation facilities.	6.56	2.09	6.56	2.05
Half of the cost of the bearing orchard[c]	22.86	7.28	22.86	7.12
Total annual fixed costs	96.46	30.72	96.46	30.06
Total cost per du.	313.98	100.00	320.89	100.00
Returns from the sale of the crop at 25 pts. per kg.	355.00		550.00	
Net returns per du. above total costs	41.02		229.11	
Production cost per kg. with av. yield				
Number of kgs. per du.	1,420		2,200	
Total cost of cultural operations	11.73		6.73	
Total on-tree cost	12.02		6.90	
Total cash costs for fruit delivered to packing plant.	15.32		10.20	
Total fixed costs	6.79		4.39	
Total cost per kg.	22.11 pts.		14.59	
Additional cost of protection against frost	1.7 pts.		1.7 pts.	

[a] Department of Agricultural Economics, University of Arizona.
[b] See Table 34 for calculation.
[c] See Table 35 for calculation.

TABLE 34

CAPITAL INVESTMENT AND ANNUAL FIXED COSTS PER DUNUM OF CITRUS ORCHARD IN ARIZONA, 1963-1964.

Item	Investment	Interest		Depreciation	
	Lebanese Pounds	Rate	Amount	Rate	Amount
Land, undeveloped	450.00	5%	22.50	..	..
Improvements to land	150.00	5%	7.50	..	..
Buildings and equipment	112.50	5%	2.81[a]	10%	11.25
Irrigation system	150.00	5%	3.75[a]	5%	7.50
Sub totals	862.50	..	36.56	..	18.75
Bearing trees, 5 year old	914.50[b]	..	22.86[a]	..	18.29
Totals	1,776.00	..	59.42	..	37.04

[a] Interest charged on half of original cost representing average investment during the life of the assets.

[b] See Table 35 for the calculation of the cost of developing the orchard.

average life of citrus trees in Texas was taken as 10 years due to losses caused by the frequent occurance of killing freezes.

The cost of caring for young orange groves in California for the first five years after planting is shown in Table 37. The cost per dunum of growing profitable bearing orange trees was calculated to be LL 627, which was somewhat lower than the cost found for the other citrus growing states. The lower net cost in California is due mainly to the earlier productivity of the trees which reached 1650 kilograms of oranges per dunum during the fifth year and reduced the cumulative cost by LL 133 from LL 760 at the end of the fourth year.

TABLE 35

ESTIMATED COST RER DUNUM OF BRINGING ORANGE TREES TO PROFITABLE BEARING AGE IN ARIZONA, 1964[a]

Item	Annual Costs Per Dunum In Lebanese Pounds				
	1st Year	2nd Year	3rd Year	4th Year	5th Year
Total initial investment 862.50[b]					
Operating costs					
Land preparation	10.13	..	..	..	..
Layout and plant	27.00	..	..	..	..
Trees: 38 at LL 7.50 each	285.00	..	..	..	..
Fertilizer: material and labor	3.38	3.38	5.25	9.00	9.00
Spray: material and labor	7.50	7.50	7.50	5.25	5.25
Irrigation labor	6.00	6.00	6.00	4.50	4.50
Water	14.06	14.06	19.69	19.69	22.50
Cultivation and weeding	30.00	30.00	30.00	30.00	30.00
Miscellaneous: Rodent control, etc.	7.50	7.50	7.50	7.50	7.50
Supervision	11.25	11.25	11.25	11.25	11.25
Taxes, insurance, etc.	12.75	12.75	12.75	12.75	12.75
Total operating costs	414.75	92.44	99.94	99.94	102.75
Annual fixed costs[c]					
Depreciation of buildings, equipment, irrigation system, etc.	18.75	18.75	18.75	18.75	18.75
Interest on investment in:					
Land, improvements, buildings, etc.	36.56	36.56	36.56	36.56	36.56
Accumulated costs through previous year at 5%	..	24.01	32.72	42.24	46.61
Half of operating cost for the year at 5%	10.36	2.31	2.50	2.50	2.57
Total costs for the year	480.24	174.07	190.47	199.99	207.24
Credit for orange fruit at 25 pts. per kg. net from packing house.	..	..	..	112.50	225.00
Yield in kgs.	..	..	..	450	900
Net cost of care of orange trees	480.24	174.07	190.47	87.49	- 17.76
Net accumulated cost	480.24	654.31	844.78	932.27	914.51

[a] Department of Agricultural Economics, University of Arizona.

[b] See Table 34 for calculations.

TABLE 36

ESTIMATED COST OF PRODUCING NAVEL AND VALENCIA ORANGES IN CALIFORNIA, 1964[a]

Item	Navel				Valencia			
	23 Trees Per Dunum, Planted 6.6 x 6.1 Meters				25 Trees Per Dunum, Planted 7 x 5.4 Meters			
	Material	Labor	Total	Percent	Material and Equipment	Labor	Total	Percent
Annual cultural operations								
Fertilizer	13.91	2.40	16.31	3.57	22.50	2.63	25.13	4.65
Disease control	—	—	9.23	2.02	—	—	—	—
Pest control (contract service charge)	—	—	41.55	9.11	20.63	—	20.63	3.82
Other pest control: gophers, snails, ants	0.6	2.40	3.00	0.66	12.00	6.75	18.75	3.47
Irrigate: 7 or 8 times, 75 to 90 cms. per du.	27.00	15.75	42.75	9.37	93.75	12.00	105.75	19.57
Weed control: mowing and spraying	10.20	9.90	20.10	4.40	12.75	6.00	18.75	3.47
Pruning and brush disposal	4.20	13.74	17.94	3.93	—	7.50	7.50	1.39
Removal and replanting trees	6.19	5.63	11.82	2.59	0.75	2.25	3.00	0.55
Maintenance and repairs	—	—	9.00	1.97	—	—	7.50	1.39
General expense	—	—	18.75	4.11	—	—	37.50	6.94
Insurance	—	—	3.00	0.66	—	—	5.25	0.97
Taxes	—	—	45.00	9.86	—	—	37.50	6.94
Miscellaneous	1.88	5.63	7.51	1.65	2.25	9.00	11.25	2.08
Total costs of cultural operations	—	—	245.96	53.90	164.63	46.13	298.51	55.24
Interest on operating capital at 6%	—	—	7.38	1.30	—	—	8.96	1.42
Total on tree-costs	—	—	253.34	55.20	—	—	307.47	56.66
Harvesting								
Picking at 4.50 pts. per kg.	—	—	59.50	13.04	—	—	70.00	12.95
Hauling[b]	—	—	10.71	2.35	—	—	30.00	5.55
Total harvesting costs	—	—	70.21	15.39	—	—	100.00	18.50
Total cash costs	—	—	323.55	70.59	—	—	407.47	75.16
Annual fixed costs[c]								
Depreciation of:								
Buildings, irrigation facilities, and equipment			23.63	5.18			23.63	4.37
5 year old profitable bearing orchard costing LL 627.15 at 4% (25 year productive life)			25.09	8.31			25.09	7.02
Interest at 6% on:								
Investment in developed land			36.00	7.89			36.00	6.66
Half of cost of buildings, irrigation facilities, etc.			8.21	1.80			8.21	1.52
Half of cost of developing bearing orchard			18.81	6.23			18.81	5.27
Total annual fixed costs			111.74	29.41			111.74	24.84
Total costs per du.			435.29	100.00			519.21	100.00
Returns from sale of fruit at 25 pts. per kg.			562.50	—			637.50	—
Net returns per du. above total costs			127.21	—			119.19	—

[a]Reports on costs and returns from oranges prepared by Extension personnel in various counties of California.
[b]Cost per kilogram for hauling Valencias was 1.5 piasters and 0.63 piasters for Navels.
[c]See Table 37 for calculations.

PRODUCTION COST PER KILOGRAM WITH AVERAGE YIELDS

Number of kgs. per du.	2250	..		2250	..
Total cost of cultural operations	10.93	..		11.94	..
Total on-tree cost	11.26	..		12.06	..
Total cash costs for fruit delivered to packing plant	14.38	..		15.98	
Total fixed costs	4.97	..		4.38	
Total cost per kg.	19.35	..		20.36	
Additional cost of protection against frost[d]	4.00	..		4.00	

[c]See Table 40.

TABLE 37

CAPITAL INVESTMENT[†] AND ANNUAL FIXED COSTS PER DUNUM OF ORANGE ORCHARD IN CALIFORNIA, 1963

	Investment Lebanese Pounds	Interest Rate	Interest Amount	Depreciation Rate	Depreciation Amount
Land leveled ready for irrigation	600.00	6%	36.00	..	..
Buildings and equipment	150.00	6%	4.50[a]	10%	15.00
Irrigation system	75.00	6%	2.25[a]	5%	3.75
Pump, motor, and well	48.00	6%	1.46[a]	10%	4.88
Sub-totals	873.75	..	44.21	..	23.63
Developed orchard (5 years old)[b]	627.15	6%	18.81	4%	25.09
Totals	1,500.90	..	63.02	..	48.72

[a]Interest charged on half of original cost representing average investment during the life of the assets.

[b]See Table 38 for calculation of cost.

TABLE 38

ESTIMATED COST PER DUNUM OF BRINGING ORANGE TREES TO PROFITABLE BEARING AGE IN CALIFORNIA, 1963[a]

	Annual Costs Per Dunum in Lebanese Pounds				
	1st Year	2nd Year	3rd Year	4th Year	5th Year
Total initial investment[b]	873.75	..	..	..	..
Operating costs					
Land preparation	30.00	..	..	..	..
Trees: 40 trees at LL 8.25	330.00	..	..	..	..
Replant trees: 1 tree at LL 8.25	..	8.25	..	..	..
Fertilizer: $CaNO_3$ at 20 pts. per kg.	1.50	3.00	..	..	..
Fertilizer application	1.50	1.50	1.50	1.50	1.50
Pest control: materials	3.75	6.00	9.00	13.13	16.88
Pest control: application	2.25	3.38	4.50	7.50	11.25
Irrigation labor	13.50	7.50	7.50	9.00	9.00
Water at 1.5 pts. per cubic meter	2.50	3.38	4.50	6.75	9.00
Tillage and weed control	11.25	11.25	9.00	9.00	9.00
Miscellaneous labor and materials	7.50	7.50	3.75	3.75	3.75
Repairs to equipment, except tractor	3.75	3.38	4.50	5.25	5.25
Taxes	10.35	10.35	10.35	10.35	15.94
Miscellaneous expenses	9.00	1.88	1.13	1.95	2.40
Total operating costs	430.35	67.37	60.23	77.18	95.22
Picking: Av. 3.24 pts. per kg.	..	..	14.58	29.16	53.46
Hauling: Av. 0.87 pts. per kg.	..	..	3.92	7.83	14.36
Total harvesting costs	..	..	18.50	36.99	67.82
Total operating costs	430.35	67.37	78.73	114.31	16.04
Annual fixed costs[b]					
Depreciation of buildings, equipment	23.63	23.63	23.63	23.63	23.63
Interest on investment in:					
Developed land	36.00	36.00	36.00	36.00	36.00
Buildings, equipment, irrigation system, etc.	8.21	8.21	8.21	8.21	8.21
Accumulated costs through the previous year at 6%	..	30.67	40.74	45.34	45.62
Half of operating costs for the year at 6%	12.91	2.02	1.81	2.23	2.86
Total fixed costs	80.75	100.53	110.39	115.50	116.32
Total costs for the year	511.10	167.90	189.12	229.67	279.36
Credit for oranges harvested					
Kgs. per du.	..	..	450	900	1650
Value at 25 pts. per kg.	..	..	112.50	225.00	412.50
Net costs for the year	511.10	167.90	76.62	4.67	133.14
Accumulated cost of citrus orchard	511.10	679.00	755.62	760.29	627.15

[a]Fresno County Agricultural Extension Service.
[b]See Table 37 for calculations.

Prices Received By Producers For Oranges in The United States

Table 39 reports the average prices received by producers for oranges in the four commercial citrus producing states of the United States from 1954-1955 through 1962-1963. For the four year period 1957-1958 through 1960-1961, the average price received by farmers selling oranges in Florida, Texas, Arizona and California was approximately 20 piasters per kilogram. This amount compares favorably with what producers in Lebanon consider a normal price. A comparison of average price received with average production costs of 12-20 piasters per kilogram mentioned previously reveals that these were profitable years for orange growers in the United States. Though prices prevailing since 1961 have been lower, producers with average costs per kilogram received returns sufficient to cover their expenses.

The general relationship between costs and returns from oranges in the four producing states for 1962-1963 is indicated by the following figures.

	Florida	Texas	Arizona	California
	Lebanese Piasters Per Kilogram			
On-tree price for all sales [1]	15.00	28.90	24.29	24.44
Cost of production with average yield	10.72	10.83	14.29-22.11	19.35-20.26
Additional cost for frost protection	1.00	3.45	1.70	3.98
Total cost of production	11.72	14.28	15.99-23.81	23.33-24.34

The prices reported are the average for fruit sold for consumption in fresh form and for fruit sold to the processing plants which pay substantially lower prices most years, as shown in Table 39. Allowing for a margin of error in the data representing the expenses of producing oranges in the various states, the above differences between selling prices and cost of production indicate the general profitability of orange production in the United States. When frost requires firing the heaters so that the cost increases, the price of oranges usually goes up.

[1]Prices received by producers as reported by them to the Crop and Livestock Reporting Service of the United States Department of Agriculture.

TABLE 39

SEASON AVERAGE ON-TREE PRICE OF ORANGES RECEIVED BY PRODUCERS IN THE UNITED STATES LEBANESE PIASTERS PER KILOGRAM 1954-1955 THROUGH 1962-1963[a]

Year	Average Four States			Florida			Texas			Arizona			California		
	Fresh use	Processing sales	All sales	Fresh use	Processing sales	All sales	Fresh use	Processing sales	All sales	Fresh use	Processing sales	All sales	Fresh use	Processing sales	All sales
1954-1955	14.27	9.22	11.49	10.39	9.88	10.02	11.05	5.20	10.17	16.02	7.17	13.76	18.15	5.85	14.71
55 - 56	17.93	12.28	14.78	13.61	13.54	13.54	12.00	8.63	11.49	23.12	9.44	21.73	22.02	6.44	17.78
56 - 57	16.68	9.59	12.44	12.22	9.59	10.24	11.27	5.12	9.88	19.68	9.37	18.88	20.78	9.66	18.00
57 - 58	24.44	15.88	19.10	14.63	15.95	15.66	11.56	4.90	10.83	37.90	17.34	36.66	33.88	7.24	31.10
58 - 59	21.66	19.76	20.49	20.34	21.15	21.00	17.49	14.78	16.98	28.83	8.56	27.59	22.54	10.98	19.46
59 - 60	21.95	13.68	16.76	14.78	14.20	14.34	14.05	9.37	13.10	25.61	6.07	22.02	28.98	9.95	24.15
60 - 61[b]	27.37	20.71	22.98	23.05	21.51	21.80	18.07	10.17	16.02	34.83	10.46	32.05	31.98	12.37	27.66
61 - 62	23.34	13.32	16.10	15.00	13.46	13.76	15.00	8.27	11.93	38.05	9.73	32.27	34.32	11.20	28.68
62 - 63[b]	28.98	12.95	17.71	24.95	13.17	15.00	28.90	..	28.90	32.85	9.07	24.29	31.32	11.93	24.44
Av. 1957 1961	23.86	17.51	19.83	18.20	18.20	18.20	15.29	9.81	14.23	31.79	10.01	29.58	29.35	10.14	25.59

[a]Crop and Livestock Reporting Service, United States Department of Agriculture.
[b]Crop reduced by freeze in Florida which caused higher prices.

Since the reported costs of producing oranges in the United States are so much lower than the costs found in Damour and South Lebanon, analysis of the costs in the United States can indicate possible ways to reduce the costs of growing oranges in Lebanon.

Extra Cost of Protection Against Frost

Studies in various citrus producing areas of the United States reveal that the cost of protecting orchards against frost damage amounts to 1-4 piasters per kilogram of harvested fruit.

In those citrus growing areas subject to freezing temperatures periodically, protection against frost requires maintaining heaters in a ready-to-light condition during periods when weather reports forecast possible freezing temperatures. Many farmers, who do not wish to rely solely on general area-wide weather reports, keep accurate thermometers so that they can readily supply heat should temperatures suddenly drop to a critical point. Citrus producers in these areas have to bear the extra expense of the depreciation of the equipment and interest on the capital invested therein even though no frost occurs during several years.

Atmospheric conditions in some areas of California often produce a static layer of dense air just above the tops of the citrus trees. It has therefore become a common practice in these areas to use giant diesel or electrically operated fans, called wind machines, to move currents of heated air through the branches of the trees, mixing with the colder air to raise the temperature several degrees. The use of these machines has proven to yield more economical results in getting temperatures above freezing than is the case for the use of heaters alone.

Even though there may not be a single frosty night during the cold season, orchards owners must have equipment in readiness to give protection whenever the need may arise. Thus, there are the annual fixed costs of depreciation of the equipment and interest on the capital invested in the equipment to be borne every year. This is called the frost protection stand-by expense.

Though frost equipment can raise the temperature of the air among the branches of citrus trees as much as 10 degrees Fahrenheit, under usual atmospheric conditions most equipment is effective in raising the

temperature from 3 to 5 degrees. Each heater burns up to 4 liters of fuel oil per hour. In Texas it has been found necessary to keep the heaters burning eight hours during frosty nights. Workers must be on hand to tend the heaters and the wind machine.

The investment in frost equipment for a dunum of orange orchard in California and Texas is shown in Table 40. Operating costs, depreciation, and interest are also revealed in the table. While the cost per dunum is but LL 96 in California compared with LL 115 in Texas, the lower yield in California makes the cost of frost protection about the same per kilogram of oranges in these two states. In Arizona studies of the cost of producing oranges found that the annual average cost of frost protection was LL 33.75 per dunum. This cost was reported as being equivalent to 1.7 piasters per kilogram of fruit harvested. The data on costs for Florida orange groves do not show frost protection as a separate cultural operation. However, it appears that with the higher yields per dunum in that state the cost of frost protection is about 1 piaster per kilogram of citrus fruit.

TABLE 40

ESTIMATED COST OF PROTECTING A DUNUM OF CITRUS ORCHARD IN THE UNITED STATES FROM FROST DATA FOR YEARS 1962 - 1963.

Items	Texas[a]		California[b]	
		Lebanese Pounds		Lebanese Pounds
Equipment used				
Oil burning orchard heaters	15 per du.	360.00	4 per du.	112.50
Thermometers, portable and storage tanks, etc.		90.00		. .
Wind machine		. .		262.50
Cost of equipment		450.00		375.00
Operating costs				
Labor		6.00		5.63
Electricity or gasoline for wind machines		. .		33.75
Fuel oil for orchard heaters		50.40		
Annual fixed costs				
Depreciation at 10%		45.00		37.50
Interest at 6% on half the cost of equipment		13.50		11.25
Total cost for an av. year		114.90		95.63
Av. yield per du. in kgs.	3,300		2,400	
Cost per kg. of fruit		3.45 pts.		3.98 pts.

[a]Guide for Citrus Protection, Texas A & M University, College Station, B-1002, December 1963, p. 37.

[b]Based on reports of costs prepared by Extension personnel in various citrus producing counties.

ANALYSIS OF COMPARATIVE COSTS OF PRODUCING ORANGES IN LEBANON AND OTHER SELECTED COUNTRIES

Study of the costs of producing oranges in Lebanon and in the other countries for which data has been assembled in Table 41 shows that the costs of cultural operations for growing a crop of oranges per dunum of orchard in Lebanon are higher than in the other countries. Annual fixed costs are also higher in Lebanon, except for long established citrus groves in Italy and Spain where prices are risen very high following several years of profitable market returns. However, fixed costs in the newer citrus areas of those countries are substantially less than in Lebanon.

Cultural Costs

The total costs of cultural operations performed by producers of oranges in Damour and South Lebanon in 1963 averaged LL 372 per dunum compared with LL 247 in Italy, LL 178 in Spain, and LL 197 in the citrus areas of the United States. Examination of the cost figures for the various countries assembled in Table 41 indicates that costs in Lebanon are higher than in other countries in several respects.

1. Fertilizers

The total cost of manure, chemical fertilizers, and the labor for applying these to the trees averaged LL 113 per dunum in Lebanon compared with LL 60 in Italy, LL 21 in Spain, and LL 31 in the United States. The greatest part of this difference was the use of animal manure in Lebanon at a cost of LL 71 per dunum. This material is not used in citrus orchards in Spain or the United States as a regular practice. Italian citrus producers, who use manure mostly from their own animals, apply only about one-fifth of the amount of manure put on citrus trees in Lebanon.

The cost of chemical fertilizer and the labor to apply it averaged LL 41 in Lebanon for 1963 compared with about LL 45 in Italy, and LL 21 in Spain, and LL 31 in the United States. Part of the difference in these figures is explained by the fact chemical fertilizers in Europe and America are lower in cost.

Table 41

COMPARATIVE COSTS OF PRODUCING ORANGES IN LEBANON, ITALY, SPAIN, AND THE UNITED STATES, 1959-1963

Items of Cost	Lebanon		Italy	Spain	United States					
	Damour	S Lebanon			Florida	Texas	Arizona		California	
							Navels	Valencias	Navels	Valencias
Annual cultural operations				(Combined with labor given below)	(Combined with labor)					
Materials										
Manure	68.00	73.20	12.42	..	..	..	..	..	..	..
Chemical fertilizers	37.30	31.80	40.71	..	50.46	..	..	..	13.91	22.50
Spray and dust chemicals	63.00	72.80	9.76	..	27.40	..	..	..	..	..
Irrigation water	10.00	12.00	40.71	..	..	9.00	45.00	45.00	27.00	93.75
Miscellaneous	16.30	17.30	5.00	..	..	..	..	..	6.79	12.75
Labor										
Fertilizing	7.50	6.60		21.28[a]		23.25[a]	21.56[a]	19.69[a]	2.40	2.63[a]
Spraying	18.00	20.00	61.17	7.42[a]		50.40[a]	5.63[a]	5.63[a]	50.78[a]	20.63
Irrigating	14.00	10.00		21.89[a]		6.75	9.00	9.00	15.75	12.00
Cultivation and weeding	60.00	52.50		79.04	77.93	23.25[a]	15.75[a]	15.75[a]	20.10[a]	18.75[a]
Pruning and removing branches	16.00	10.50	22.43			3.00	16.50	..	17.94[a]	7.50
Miscellaneous	63.20	62.60	..	6.07		..	..	..	8.03	9.00
Other costs										
Miscellaneous	..	..	..	..	11.10	8.25	53.06	53.06	38.26	61.50
Taxes	..	..	50.00	42.32	14.58	7.50	..	..	45.00	37.50
Total costs of cultural operations	374.00	369.30	247.20	178.02	181.07	131.40	166.50	148.13	295.96	298.51
Interest on operating capital for 6 months	14.96	14.77	9.89	7.12	5.43	3.93	4.16	3.70	7.38	8.96
Total on-tree costs	389.06	384.07	257.09	185.14	186.50	135.33	170.66	151.83	253.00	307.00
Picking and hauling	50.90	42.70	54.37	69.13	110.40	118.22	46.86	72.60	70.00	100.00
Total cash costs	439.96	426.77	311.46	254.27	296.90	253.55	217.52	224.43	323.00	407.00
Annual fixed costs										
Depreciation of:										
Bearing trees	56.95	39.05	40.00	121.61	15.50	65.19	18.29	18.29	25.09	25.09
Facilities, equipment, etc.	10.20	17.20			..[b]	..[b]	18.75	18.75	23.63	23.63
Interest on:										
Land and improvements	385.62	245.40	450.00	72.95	34.09	22.50	30.00	30.00	36.00	36.00
Half of cost of facilities, etc.	5.76	11.12			..	..	6.56	6.56	8.21	8.21
Half of cost of bearing trees	113.89	78.11		243.21	23.26	19.56	22.86	22.86	18.81	18.81
Total annual fixed costs	572.42	390.88	490.00	437.77	72.85	107.25	96.46	96.46	111.74	111.74
Total costs per du.	1012.38	817.65	801.46	692.04	369.75	360.80	313.98	320.89	435.29	519.21
Average yield per du. in kgs.	3,450 kg.	3,100 kg.	2,642 kg.	4,460 kg.	3,450 kg.	3,330 kg.	1,420 kg.	2,250 kg.	2,250 kg.	2,550 kg.
Cost per kg. in pts.	29.72	26.38	30.34	15.52	10.72	10.83	22.11	14.59	19.35	20.36
Extra Cost for frost protection, per kg.	None	None	None	None	1.00	3.45 pts.	2.48 pts.	1.53 pts.	3.98 pts.	3.98 pts.

[a]Includes materials in addition to the labor

[b]Depreciation of equipment included in costs of cultural operations.

2. Protection against diseases and insects

Lebanese citrus producers spend annually about LL 80 per dunum for insecticides and fungicides and their application for the control of plants diseases and insects. Italian and Spanish growers spend less than a fourth of this amount. Spanish producers are increasing their spraying to control aphids which transmit the Tristeza virus. Table 41 reveals that the costs of purchasing and applying spray materials in orange groves of the United States average less than half the cost of this operation in Lebanon.

3. Irrigation water

Irrigation costs include obtaining the supply of water when needed and getting it to the trees. The cost of this operation is moderate in Lebanon. Producers in Spain and in three of the four citrus growing states in America pay two to four times more for their irrigation water. The labor costs for irrigating orange trees in Lebanon is in line with the cost in the other countries studied.

4. Cultivation and weeding

The cost of cultivating between the trees and removing weeds by hand-labor is a major expense item for growing citrus in Lebanon. It averages LL 56 per dunum annually. This amount is not excessive in relation to costs in Italy and Spain where much of the cultivation is also done by hand. However, cultivation costs of Lebanese orange growers are about three times more than those experienced by growers in the United States where tractors are used for cultivating between the trees and weeds are usually controlled by application of an oil spray or a chemical weed killer.

5. Miscellaneous.

Miscellaneous cultural costs amount to about LL 62 per dunum in Lebanon. They were found to compare favorably with those in other countries whose costs were reviewed. Taxes are a major cost item for citrus growers in Italy and Spain whereas Lebanese producers do not have this expense. Taxes are also an important cost in California being considerably higher than in the other three American states that produce oranges.

Annual Fixed Costs

In Lebanon, the annual fixed costs of depreciation and interest on the capital invested in the orange orchard are the most important elements in the cost of production. Comparative figures on capital investment in orange orchards and related fixed costs in various countries are given in Table 42. As pointed out earlier, fixed costs constitute 56 percent of the total cost of production in Damour and 48 percent in South Lebanon. In areas of Italy where oranges are grown commercially, inflation of the selling prices of profitable producing orange orchards has raised the interest on capital invested to 56 percent of the total cost of production. In similar areas of Spain, fixed costs amount to over two-thirds of total costs. In the United States, the annual fixed costs are in the range of 20 to 30 percent of the total cost of producing oranges.

1. Depreciation

Depreciation of bearing trees averaged LL 47 per dunum in Lebanon. In Italy and Spain this annual depreciation charge is considerably higher in the areas of commercial citrus production where it ranges from LL 75 to LL 100. As indicated earlier, the higher prices of profitable citrus orchards in these countries are due to a recent practice of competitive bidding among those who have money to invest and who seek to gain immediately the high profits from selling the annual harvest at remunerative prices instead of planting a new orchard.

Depreciation of bearing orange trees in the United States is in the relatively low range of LL 15 to LL 25 when compared with LL 39 in South Lebanon and LL 56 in Damour. The primary reasons for the higher depreciation charge in Lebanon are the much higher cost of caring for the trees during seven as compared with five years in the United States, and also the higher annual interest cost during the development period. Interest at 6 percent was charged on the very high price of land and 8 percent interest on the annual operating costs. These interest charges accumulate at compound interest during the seven year developmental period. The rates of depreciation charged in the various countries are shown in Table 42.

The annual depreciation of the irrigation facilities, buildings,

TABLE 42

CAPITAL INVESTMENT PER DUNUM OF ORANGE ORCHARD IN LEBANON, ITALY, SPAIN, AND THE UNITED STATES, 1959-1963

Items	Lebanon[a] Damour			Lebanon[a] S. Leb.	Italy[b]			Spain[c]			Florida[d]			Texas[e]			Arizona[f]			California[g]		
	Leb. Pds.	Dep. %	Int. %	Leb. Pds.	Leb. Pds.	Dep. %	Int. %	Leb. Pds.	Dep. %	Int. %	Leb. Pds.	Dep. %	Int. %	Leb. Pds.	Dep %	Int. %	Leb. Pds.	Dep. %	Int. %	Leb. Pds.	Dep. %	Int. %
Interest on :																						
Land, undeveloped	6,000	0	6	3,500													450	0	5			
Improvements to land terraces, etc.	427	0	6	590	1,000	0	6	1,200	0	6	568	0	6	375	0	6	150	0	5	600	0	6
Irrigation facilities, etc.	100	5	8	228													150	5	5	75	5	6
Windbreaks, fences, etc.	36	10	..	42	2,750	10	6							..	..	..	..	..	..	..	..	..
Equipment, machinery, tools	8	20	8	8				6,100	2	8	..[h]	..	..	..[h]	..	..	112	10	5	200	10	6
Profitable bearing trees	2,819	2	8	1,952	3,750	2	6				775	2	6	652	10	6	915	2	5	627	4	6
Total investment per dunum	9,390	..	..	6,320	7,500	..	..	7,300	..	..	1,343	..	..	1,027	..	..	1,777	..	..	1,502	..	..

[a]Data from Table 11
[b]Data from Table 25
[c]Data from Table 28
[d]Data from Table 29
[e]Data from Table 31
[f]Data from Table 34
[g]Data from Table 37
[h]Cost of machinery, equipment, etc., not reported separately. Depreciation and interest on these items included in costs of various cultural operations.

and equipment of Lebanese producers of oranges are moderate, averaging only LL 13.50 per dunum. Growers in the United States own tractors and other machinery for cultivating, spraying, and performing other cultural operations. Thus, their annual depreciation charges are about double those in Lebanon. Those who hire these operations, particularly spraying performed by companies specializing in the care of citrus groves, have annual depreciation charges that are about 50 percent higher than those of Lebanese producers.

2. Interest on investment in land and improvements

Interest on the money invested in high priced land and the improvements made to the land when establishing a citrus orchard is the largest single item of cost for producers of citrus in Lebanon. It constituted 38 percent of the total cost of production in the Damour area and 30 percent in South Lebanon. The interest cost for producers in those areas averaged LL 315 per dunum as found in the survey made in 1963. This was nearly 10 times the interest cost for owning citrus land in the United States. The interest cost for citrus growers in the areas of Italy and Spain, where there is inflation in the price of bearing citrus groves, is about the same as in Lebanon.

3. Interest on bearing trees

The annual interest on the cost of developing an orchard of bearing orange trees in Lebanon averaged LL 95 per year compared with an average of LL 21 in the United States where interest rates are lower. An additional factor is that most orange groves in the United States reach profitable bearing in five years as compared to seven years in Lebanon. The shorter developmental period in the United States is due to the fact that American citrus growers set out strong trees that have been grown in a nursery for a year after budding instead of setting out seedling trees and budding them the second year as is practised in Lebanon. The lower interest rates prevailing in the United States are indicated in Table 42.

4. Interest on other productive assets

The interest cost for such productive assets as irrigation

facilities and equipment used to produce oranges in Lebanon amounted to an average of LL 8.50 per year. This interest cost is about LL 1 less in the United States where cultural operations for many orchards are performed by orchard-care companies for stated contract charges. This practice reduces the investment in machinery and equipment by orchard owners who utilize the services of these companies. Thus, the interest cost for their orchards are lowered. Actually, interest on the capital tied up in the equipment of the orchard-care company is included in the charges made for its services. Therefore, interest on the capital invested in machinery for performing cultural operations is paid indirectly by the patrons of the orchard companies, but in less amount because the machinery serves a number of groves rather than just one.

Summary of Comparison of Costs

The above comparative analysis of production costs in Lebanon with those of Italy, Spain, and the United States shows that the costs of producing oranges in Lebanon are high relative to the following:

1. Animal manure
2. Chemicals for controlling diseases and pests
3. Cultivation and weeding
4. Depreciation of the bearing trees
5. Interest on the investment in land, improvements, and the bearing trees.

Possible ways to reduce these costs will be discussed in the next section.

WAYS TO REDUCE PRODUCTION COSTS

Since oranges and bananas are sold by the kilogram, net returns of producers can be increased most successfully by reducing the cost of production per kilogram of fruit harvested. Lower per kilogram costs can be achieved by reducing the expense of growing the crop and by increasing the yield. Some expenses such as fertilizer and irrigation may be increased to obtain higher yields, thus lowering the cost per kilogram of fruit harvested and marketed. Attention needs to be given both to reducing particular expenses and to obtaining higher yields.

In Producing Oranges

Ways to Reduce Expenses

Since the costs of cultural operations constitute about 40 percent of the total cost of growing a crop of oranges, attention is given first to possible ways of reducing these costs.

1. Fertilization

The major item of fertilizer is animal manure, amounting to LL 71 per dunum. Green manure cover crops have been found to be economical in the United States for replacing animal manures for maintaining the organic matter in the soils of citrus orchards. The cost of growing a cover crop and incorporating it into the soil is moderate. In Florida the cost of the seed for a dunum was LL 2.65 in 1962. The 1963 annual cost of tractor cultivation of a dunum of orchard was LL 15 in Arizona.

Research is needed to determine what type of cover crop to use for green manure under Lebanese orchard conditions and if such type of cover crop could replace animal manure and to what extent. Research should also be undertaken on no-cultivation in citrus orchards as this type of care reduces the need for manure once the proper level of organic matter is established in the soil.

2. Spraying to control diseases and insects

Since Lebanese citrus producers are spending about twice as much as American producers for spraying, worthwhile savings appear possible. Observation indicated that growers are making a

large number of sprayings than necessary to control pests and diseases. It was also found that growers are using spray materials which are considerably more expensive than other more effective chemicals.

3. Cultivation and weeding

Cultivation and weeding Lebanese citrus orchards with hand-labor costs about three times more than machine cultivation and killing weeds with oil sprays and/or weedicides in the United States. Light motor driven rotivators (walk behind type) have been tried in Lebanon. They are very effective in weed control and cultivation. The initial cost is low (LL 3500) and the cost of operation is economical.

These costs require careful consideration because they constitute 48 to 56 percent of the total cost of producing oranges in Lebanon. Depreciation, as an annual cost, is calculated on the original cost of the irrigation facilities, machinery and equipment, and the cost of the bearing trees at the end of seven years after planting. Since the number of years of useful life of these items can be extended very little by more careful care and attention, the primary means to lowering annual depreciation charges is to reduce the original cost. The only fixed cost item which the grove owner can reduce is the cost of growing the trees to profitable bearing age. This reduction could be achieved by setting trees with a sufficiently wide spacing to permit tractor cultivation thus reducing the amount of expensive hand-labor. However, careful drivers are required to avoid serious injury to the trees by tractors and the machines they pull.

4. Reduction of interest rate

Another way to lower the cost of a developed orchard would be to reduce the interest rate on operating loans from 8 to 6 percent. The Ministry of Agriculture is developing plans for a supervised credit program which would make production loans available to farmers at 6 percent annual interest. If orange producers could secure their operating capital at 6 percent, they could achieve the following savings.

a.) Reduction in the cost of growing a developing orchard for seven years.

	Damour	South Lebanon
Cost of 7 year old orchard		
When the interest rate is 8 percent	LL 2,947	LL 1,952
When the interest rate is 6 percent	2,566	1,704
Reduction in the cost of 1 dunum of bearing trees	LL 381	LL 248
b.) Reduction in interest cost on money invested in:		
Land, improvements, irrigation facilities, etc.	1.44	2.78
Bearing trees	36.91	26.99
Annual expenses for cultural operations	3.74	3.69
Total saving in interest	42.09	33.46
c.) Reduction in depreciation of the bearing trees	5.63	4.97
Total saving in interest and depreciation	LL 47.72	LL 38.43

When these savings are related to the annual costs of growing a dunum of oranges in Damour and South Lebanon amounting to LL 1,010 and LL 818, respectively, they reduce the cost of production by 4.7 percent. The annual fixed costs for interest and depreciation are lowered by 8.3 percent for Damour and 9.8 percent for South Lebanon.

Ways to Increase Yields

Improved cultural practices can greatly increase yields. Some of the important improved practices which contribute to higher yields are the following. These improved practices are explained in the Appendix.

1. Selection of rootstock and scion

Higher yielding citrus trees come from buddlings produced by inserting buds from carefully selected healthy, high yielding trees

into strong seedlings grown from seeds of healthy sour orange trees.

2. Ample fertilization

At least 2 tons of animal manure per dunum (or a green manure crop supplying the equivalent amount of organic matter) should be used along with 3 to 5 kilograms of nitrogenous fertilizer (20 to 21 percent) and 3 to 3.5 kilograms of super-phosphate per mature tree. Essential micro-elements need to be supplied where required, particularly zinc, iron, magnesium, manganese, and boron. Balanced amounts of chemical nutrients enable the trees to grow vigorously and take up the amount of plant food required to produce a harvest of more than 4,000 kilograms per dunum.

3. Shallow cultivation

Shallow cultivation to a depth of 7 centimeters by a light-weight tractor or rotovator keeps the soil in proper condition for healthy growth as effectively as hand labor and at considerably less expense. It eliminates weeds that take moisture and nutriment needed by the trees, thereby fostering healthy growth of the fruits.

4. Proper irrigation

Orange trees produce maximum yields when irrigated at intervals appropriate for normal tree growth with the amount of water which maintains productive growth of both the tree and the fruit. The trees also require ample drainage to keep the excess water from an irrigation or rain below the normal depth for the feeding roots.

In Producing Bananas

The economic way to reduce the cost of producing a kilogram of bananas is to follow those cultural practices which produce high yields without increasing the cost correspondingly. These are discussed in the Appendix.

Way to Reduce Expenses

Mechanical cultivation

Cultivation with a light weight rotovator chopping the soil to a depth of not more than 7 centimeters is much less expensive than

doing the work manually. Operators must be careful in guiding the rotovator not to injure the plants.

Ways to Increase Yields

1. Maintenance of humus in the soil

Each banana tree requires the recommended amount of animal manure annually until it is demonstrated that a green manure crop incorporated into the soil mechanically is a more economic source of humus, if found feasible under Lebanese orchard conditions.

2. Application of recommended amounts of chemical fertilizers

Applying less than the recommended amounts prevents the plants from attaining the optimum size of fruit. Applying more than what is recommended reduces net returns because more is spent for fertilizer than the value of the increased harvest.

3. Control of nematodes

In plantations where yields have declined due to nematodes, it is economic to apply an effective nematocide to the entire area. Killing off the nematodes enables the plants to increase the yield of fruit with the recommended amounts of chemicals fertilizers.

4. Frequent irrigations

Although the cost for the labor to irrigate the plants frequently is greater, the cost of producing a kilogram of bananas is less. Irrigation with sufficient amount of water at the proper interval for each soil type results in optimum growth of the plants and higher yields of bananas.

5. Effective windbreaks

Wind injury greatly reduces the annual harvest of bananas. Building a relatively inexpensive but effective windbreak for a banana plantation, or growing a windbreak of evergreen trees, pays good dividends from the increased yield of fruit because of the earlier start of growth in the spring.

Appendix

IMPROVEMENT OF CULTURAL PRACTICES

Cultural practices can be improved from the time the orchard is established until the time that the trees are replaced. The adoption of improved cultural practices during the early life of the orchard will greatly increase the yield and returns of the trees throughout their productive years, for both citrus and bananas. In the following discussion, these two fruit crops will be considered separately.

CITRUS

Use of Productive Seedlings and Scions

The first point to consider in establishing a citrus orchard is the tree itself. The potential production of a tree lies in its own components, the rootstock and the scion. Sour orange has been found to be the rootstock best suited for this area. It should be replaced when a substitute is found which is as good and which also shows resistance to Tristeza disease. The extent of the danger of Tristeza in Lebanon is not known. However, the virus disease should not be ignored because it may attack the crop at any time.

Sour orange seeds (or the substitute rootstock) must come from healthy trees that have shown evidence of producing uniform seedlings. The seeds must be planted in deep virgin soil and properly cared for to grow into strong seedlings. Upon transplanting the seedlings from the seed bed to the nursery or the field, utmost care should be taken in digging the seedlings out without injury to the root system. All seedlings showing physical abnormalities, weak growth and injury should be discarded. Seedling trees should be set in holes large enough for the roots to spread out.

Budding of the seedlings is very important in determining the yield of the future bearing tree. The bud wood must come from carefully selected healthy high yielding mature trees that have shown high yields with no disorders. Buds are to be placed high, at about 45 centimeters from ground level, and the buddlings should receive good care. The

care consists of regular irrigation, weeding, balanced nutrition and especially the removal of all competition for space between the buddlings and the interplants in the orchard.

Heading-back of the scion at about 80 centimeters will allow the tree to form its own well-balanced head. Only close, interferring branches are to be cut off.

If the above mentioned steps are followed, a potentially high yielding trees will be produced.

Cultural Practices Which Produce High Yields

To obtain high production from trees with inherited capability for high production, improved cultural practices must be used. Growers could save money by reducing or eliminating unnecessary practices.

1. Maintenance of organic matter in the soil

Annual manuring is necessary in citrus orchards due to the high summer temperatures and excessive cultivation that rapidly decompose organic matter in the soil. Organic matter is required to improve the soil texture and structure. This improvement encourages better root growth and reduces the incidence of disorders found in trees growing in both very heavy and light soils. Manure further supplies a number of necessary nutrients that are not supplied with the regular chemical fertilizers, or are made unavailable in the calcarious soils common in Lebanon.

A dunum of citrus requires up to 2 tons of manure annually, unless a green manure crop is worked into the soil. This is equivalent to one bag of horse or cow manure, or a half bag of goat manure per tree spaced 7 by 7 meters.

Synthetic organic fertililizers, unless quite bulky and properly fermented, will not replace animal manure or a heavy growth of a green manure crop. In groves where mechanical cultivation is feasible, a green manure crop will save part of the expenses of applying animal manure. For example, a heavy yielding crop such as a mixture of barley and large seeded vetch could be sowed late in summer and irrigated, grown during winter, and disced into the soil

in very early spring. If the soil is too wet in spring for discing, a light engine (walk behind type) mower could be used to cut the cover crop so as to stop the competition for nutrients and reduce transpiration as well as uncover the soil to keep it warm in spring at the time of bloom. When a green manure crop is plowed under, additional inorganic chemical nitrogenous fertilizer is required temporarily to feed bacteria which decompose the green cover crop and make the chemical nutrients available to the trees.

2. Application of nitrogen and phosphorus fertilizers plus micro-elements

For mature citrus trees planted at the rate of 20 trees per dunum, 3 to 5 kilograms of nitrogeneous fertilizer (21 percent N) are required per year. It is advisable to apply three-fifths of the quantity one month before bloom. Then just before the summer "flush", determine what fraction of the remaining quantity to use. This is influenced mainly by the size of the prospective crop and the size and vigor of the new growth.

In an orchard where superphosphate has not been used regularly, the use of five kilograms of superphosphate (16-17 percent P_2O_5) is required for the first year. Thereafter, 3 kilograms per tree per year should be sufficient. Further research is required to determine the exact amounts of phosphorous required under different soil conditions in citrus orchards and if an annual application is necessary.

The need for potassium is not established in citrus orchard soils in Lebanon. Some soils, such as the sandy soils, might be deficient in this element, and its addition could be useful. Under all conditions, the annual dose per tree should not exceed one to one-and-a-half kilograms. Many nutritional deficiencies could be attributed to excess potassium in orchard soils.

Correction of micro-element deficiencies is essential for the maintaining of high yields. Zinc, iron, magnesium and manganese deficiencies have been found. It is also suspected that boron deficiencies exist. Limited trials have indicated that foliar sprays could be used very effectively as a means of controlling such deficiencies.

However, soil applications if properly used could be more effective and longer lasting.

3. Cultivation

Cultivation is an expense item of great significance in Lebanon where hand labor is expensive. This expense item could be reduced by use of mechanical cultivation. The cultivation should not go deep into the soil and the machine should be light in weight so as not to compact the soil. A good type machine is the light rotovator that cultivates to a depth of 7 centimeters. Deep cultivation is harmful because it cuts off feeder roots, thereby reducing the total root surface which weakens the tree. A large proportion of the feeder roots are in the top layer of soil where the nutrients are placed and where water is abundant following irrigation.

Straw mulches, if a cheap source of straw is available, should be tried. Also, the practice of no cultivation should be tested. However, if no cultivation is to be practiced, the soil's physical structure must be put in good condition. Improved structure can be achieved by adding large amounts of organic matter for three years. Deep and efficient drainage ditches and proper irrigation systems that do not cause puddling must also be built.

4. Spraying against pests

In recent years, pesticide spraying has caused many problems and extra expenses. Due to competition on the market, pesticides of lower quality have appeared. Some of these materials have produced burning of leaves and twigs or retarded growth while others were not efficient in controlling pests. This situation could be improved by better timing of the sprays and by the use of materials that do not cause the build up of a resistant insect population. It is recommended that oil sprays and sulfur be used at the proper times for scale insects and for spider mites, respectively. These materials will cut down on the number of sprays and on the use of expensive insecticides. It has been found that resistance occurs in many instances as a result of using a smaller amount of the insecticide than recommended.

Spraying equipement in use in orchards is not adequate. Spraying rigs must develop 400 pounds per square inch of pressure

at the nozzle, not just at the pump. A high level of pressure at the pump is reduced as the number of nozzles, the length of the hose, and the number of bends in the hose are increased. Proper coverage of trees is necessary and may require ladders or spraying platforms.

5. Control of nematodes

Many kinds of nematodes that attack citrus tree roots exist in orchard soils. Unless large areas are treated at one time, the control is not effective because the number of nematodes increases again within a period of a few weeks after treatment.

6. Proper irrigation

The intervals between irrigations and amounts of water applied are determined according to soil type, depth, and age of the trees. In many areas the intervals between irrigation-turns need to be revised because trees grow better when given a sufficient amount of water at short intervals. Long intervals between irrigations when the temperature is high can cause excess dropping of immature fruit from the trees. For best growth and optimum yield enough water should be maintained in the soil at all times.

BANANAS

Cultural Practices Which Produce High Yields

1. Maintenance of water holding capacity of the soil

Banana plants respond to cultural practices which provide conditions favorable for the growth of plants that can produce large bunches of fruit. Bananas require light soils with good water holding capacity. Accordingly, light sanding and the regular addition of manure are essential. A banana tree must receive one third bag of goat manure or one half bag of horse or cow manure annually. The latter kinds are cheaper sources of organic matter.

2. Application of adequate amounts of chemical fertilizers

Nitrogen is to be applied in two applications. The first treatment should be in March consisting of 1 to 1.5 kilograms of ammonium nitrate. This application is very essential so that the tree will start early vigorous growth. The second application of 0.5 kilogram of a quickly available nitrate is made before bloom.

During the first year of a new plantation, 2 kilograms of single superphosphate are recommended per plant. Thereafter, 1 kilogram per plant per year should be sufficient.

Half a kilogram of commercial potassium fertilizer seems to be sufficient in most soils. However, some soils may require slightly more and others less.

3. Control of diseases

The two most important diseases of bananas in Lebanon are the mosaic disease and the recently discovered heart rot disease. As yet no cures are known for either of them. It is necessary, however, to follow control measures to limit the spread of the diseases in a plantation and to avoid using infected suckers in establishing a new plantation.

a) Mosaic

Banana plants infected with the mosaic virus show mottling of the leaves in the form of alternate dark and yellow or white stripes. The suckers of plants having these symptoms are also infected and should not be used for new plantings. The most important sources of infection are cucumbers, squash, tomatoes, peppers, and other host plants growing in the banana plantation or close to it. Thus, the control measure is not to grow the host plants in or near banana plantations.

b) Heart rot

The pathogen causing this disease is not yet determined. The disease is identified by dark brown decay proceeding downward from the tip of the central rolled young leaves. Cutting infected plant close to the ground before the rot enters the pseudostem may save the replacement suckers from infection. Plantations need be cleared of all diseased plants. These should be burned to avoid spreading the disease. Suckers from plantations having heart rot disease are not recommended for new plantings.

4. Control of nematodes and improvement of nutrition

Decrease in yield after the third year in a banana plantation may be due to nematodes damage and/or micro-element deficiencies.

Banana soils were found to be highly infested with nematodes. Limited experiments have shown that the control of nematodes not only increases growth, but achieves a better nutritional balance in the plant. The increase in growth, followed by increase in yields, and the more efficient uptake ot nutrients from the soil could pay for the extra expense of nematode control. When nematodes are controlled regularly, less fertilizer is required and yield will increase slightly. However, for efficient control, whole areas of orchard must receive the nematicide. Otherwise, reinfestation will occur within a short time.

Micro-element deficiencies could result from either a high population of nematodes or from actual deficiencies. They should be controlled so as to increase plant performance. Zinc and magnesium deficiencies have been found in many banana areas in Lebanon.

5. Cultivation by machinery

Cultivation cost is another important expense item in banana growing. The first cultivation has to be by hand to build the soil around the rhyzome and to stop shallow growth and upheaval. This practice will lengthen the life span of the plantation. However, further cultivations could be made by machinery as long as the cultivations are not deep, because bananas are highly sensitive to root injuy. Any machinery that cultivates to a depth of 7 centimeters and is light in weight so as not to cause soil compaction could be used. Also, those weedicides that have no effect on the banana plant growth have been found to be efficient and economical for controlling weeds in banana plantations.

6. Short periods between irrigations

For best performance bananas must neither be allowed to undergo stress for lack of moisture, nor be in a soil with excess water. If either condition occurs, retardation in growth will result and lower yields will follow. Therefore, regular light irrigations are necessary.

7. Effective windbreaks

Wind injury during winter and early spring causes severe defoliation and leaf burning in Lebanon's banana plantations. The

result is late starting of growth in the spring. This growth depends to a great extent on carbohydrate reserves in the underground parts. Growth would start earlier and more vigorously if windbreaks were improved. This practice will lead to higher yields.

The main objective of the cultural practices discussed in the foregoing is to increase the yield of citrus and bananas per dunum. The effect of high yield on costs and returns has been discussed in the sections dealing with the costs of producing these fruits in Damour and South Lebanon. In general, increasing the number of kilograms of fruit harvested from a dunum of orchard or plantation results in lower cost per kilogram and in higher returns to the farmer.

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