Lemon Industry in California

market for fresh lemons and market for lemon juice products essentially one economic market with interlocked problems

Sidney Hoos

The following article is the fifth and final of a series on the economic situation and marketing problems of the California lemon industry.

A significant problem facing the lemon industry concerns the relationships of—and interactions between—the fresh lemon market and the lemon juice products market.

The two markets are so closely bound together by direct interaction that they actually comprise a single market and—in terms of an economic and marketing framework—there exists a set of closely interlocked problems.

Product Competition

The relationships of the fresh and products markets are most evident during the summer months. During the hot weather periods, the volume of shipments absorbed by the fresh market increases seasonally, as also does the purchase of lemon juice products by consumers. But a considerable degree of competition exists between the consumption demands for fresh lemons and lemon juice products. However, that situation does not necessarily indicate a stagnant or depressed consumer demand for lemons and lemon juice products in total. When the market absorption of lemon-juice products is added to the fresh shipments—in terms of fresh equivalent—the total market disappearance appears to have increased in recent years.

The degree of consumption competition between fresh lemons and lemon-juice products—frozen concentrated lemonade and canned single-strength lemon juice—cannot be measured precisely at this stage of market development but there is reasonable evidence that such competition prevails to a significant extent in the hot weather periods. Furthermore, the degree of competition is stronger than it was several years ago when frozen lemonade concentrate was in its infancy. If the degree of competition changes, it is more likely to increase than to decrease unless recent and current market-price and consumer-preference relationships reverse their trends. Presently, however, no reason for such reversal is apparent.

In over-all terms, about 18,000 to 19,000 cars of fresh lemons are shipped annually. In recent years, that annual rate has been remarkably stable, due primarily to the operation of the federal marketing order for fresh shipments. The crop not shipped fresh is processed; but imports also are converted into products. For juice and homemade beverage uses, consumers have been buying some frozen concentrated lemonade and some canned single-strength juice manufactured domestically from imported base stock. In terms of fresh equivalent, the rate of lemon products imports now amounts to about 2,000 cars annually. Those importations must be added to the manufacture of lemon-juice products—from domestic lemons—to derive a juice figure which, when combined with fresh shipments, indicates the over-all disappearance of lemons in the United States.

When the total disappearance of lemons—fresh and processed, domestic and imported—is compared with population growth, it appears that total usage and population growth have been about in line with each other in recent years. What decline has occurred in fresh lemon consumption per capita has just about been offset by the increase in juice products consumption. But the lemon industry as a whole does not seem to have reaped significant gains from the expansion in national income during the same recent years. If prices and returns had increased in the face of a stable per capita over-all disappearance, there would have been evidence of an expansion in per capita demand. However, neither the gross disappearance nor the returns to growers reflect a strong positive effect of the increasing national income.

Comparative Returns

The fresh market is the historically important—and by far the largest outlet— for domestic lemons. In 1956, about 19,000 cars were shipped from California-Arizona producing areas to other states and to Canada and about 3,500 cars were exported. For the 19,000 cars, there was an estimated on-tree return of about \$3.15 or \$3.20 per packed box, and for the 3,500 cars exported, an on-tree return of about \$2.50 per packed box.

Those estimated returns for fresh shipments may be compared with estimated 1956 returns for products. Lemons manufactured into juice products returned about 80¢ per packed equivalent box, on-tree basis; and lemons manufactured into citric acid yielded a negative return of about minus 50¢ per packed equivalent box, on-tree basis.

The substantially higher per box returns from fresh shipments were possible because part of the crop was diverted to the products outlets. Without such diversion, the fresh shipping price would have been considerably lower. The ideal allocation between the fresh and products outlets is that which yields the highest over-all return for the crop as a whole.

Crop Allocation

One of the major reasons for introducing the federal marketing order for fresh lemon shipments was to provide a vehicle for enforcing industrywide proportional compliance with the regulation of fresh shipments. The establishment and operation of the federal order reflect the industry's planned operations to obtain increased returns from the crop.

The situation in the past five or six years—in certain respects—was not different from the earlier years. But, in terms of the structure of the products market, a significant change has oc-

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NITRATE

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by means of calcium nitrate. The water-soluble calcium in the dry matter increased gradually from 12.89% to 18.55%. Because of the large content of calcium in the dry matter of the leaves, the potassium percentages were greatly reduced as the addition of calcium nitrate was increased. The leaves were all dark green in color and healthy in appearance with no symptoms of a copper deficiency becoming apparent. In the dry matter of the leaves the total phosphorus increased when the nitrate content of the nutrient was low. The percentages of potassium in the dry matter of the rootlets tended to increase, whereas those of total phosphorus were decreased as the nitrate level was increased. In the dry matter of the peel and pulp of the fruit, the percentages of calcium, potassium, and total phosphorus decreased as the nitrate levels increased.

Effect of Nitrate

The maximum yield in pounds was produced at the 250 nitrate level—roughly at the 56 ppm nitrogen level—with the second highest yield in pounds at the 550 nitrate level—roughly 124 ppm nitrogen. The pounds of fruit produced when multiplied by 454—one pound equals roughly 454 grams—and divided by the number of fruit gives the grams weight per fruit. These results in the table on page 9 clearly show the effects of the nitrate level in increasing the pounds of fruit produced—yield—while at the same time decreasing the size of the lemon.

The tabulated data on this page would indicate that such increased, or possibly overproduction of lemon fruit as the trees increase in age, gradually would use up the food reserves in the trees so nearly to completion that the onset of tree decline might become apparent. The severe pruning of such trees temporarily reduces the crop and increases the vegetative growth, thereby permitting the accumulation of food reserves which are once more reduced to injurious levels when the fruit production again is increased.

The use of nitrogen as the sole fertilizer—under certain conditions—can result in a more or less cyclical production of lemon fruit of desirable size.

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The above progress report is based on Research Project No. 1086.

Composition in January of Leaves and Rootlets and of Peel and Pulp of Fruit from Eureka Lemon Trees on Sour Orange Rootstock Grown in Large Out-of-Door Soil Cultures with a Nutrient Solution Containing Various Concentrations of Nitrate

Parts per million nitrate in nutrient	25	50	75	100	125	150	250	350	450	550	600
Leaves:											
Calcium (Per cent in dry matter)	2.84	3.98	4.82	4.56	4.63	5.53	6.52	6.16	5.97	7.13	6.85
Magnesium (Per cent in dry matter)	.29	.30	.15	.17	.16	.20	.23	.16	.18	.21	.21
Potassium (Per cent in dry matter)	2.49	2.45	2.78	2.00	1.78	1.56	.75	.53	.71	.47	.49
Total phosphorus (Per cent in dry matter)	.24	.20	.13	.11	.11	.11	.12	.13	.12	.11	.11
Dry matter as per cent in fresh weight	32.95	31.15	34.96	36.34	36.24	37.78	41.04	41.32	41.06	42.59	43.46
Rootlets:											
Calcium (Per cent in dry matter)	1.09	3.01	1.02	2.64	2.24	2.55	2.30	1.82	2.03	.98	1.96
Magnesium (Per cent in dry matter)	.41	.35	.37	.39	.40	.47	.42	.40	.31	.21	.28
Potassium (Per cent in dry matter)	.95	1.27	.92	1.11	1.20	1.14	1.15	1.43	1.34	1.56	1.52
Total phosphorus (Per cent in dry matter)	.15	.15	.12	.10	.10	.10	.09	.10	.09	.08	.09
Peel:											
Calcium (Per cent in dry matter)	1.20	1.33	1.49	1.12	1.19	.93	.85	.93	.85	.97	.89
Magnesium (Per cent in dry matter)	.08	.10	.09	.09	.11	.10	.10	.09	.10	.09	.09
Potassium (Per cent in dry matter)	1.48	1.09	1.13	1.02	.85	.91	.83	1.01	.94	.86	.81
Total phosphorus (Per cent in dry matter)	.13	.09	.10	.07	.07	.07	.07	.08	.08	.08	.07
Dry matter as per cent in fresh weight	17.99	18.85	18.89	19.12	19.47	18.46	19.33	19.44	18.31	17.80	18.32
Fresh weight as per cent of whole fruit weight	31.91	29.44	33.11	40.56	33.93	37.68	36.41	30.22	34.06	35.62	34.22
Pulp:											
Calcium (Per cent in dry matter)	.41	.32	.37	.32	.32	.27	.27	.28	.30	.32	.29
Magnesium (Per cent in dry matter)	.11	.12	.11	.11	.12	.11	.10	.10	.11	.11	.11
Potassium (Per cent in dry matter)	2.30	2.22	2.23	1.92	2.02	1.76	1.77	1.70	1.91	1.87	1.75
Total phosphorus (Per cent in dry matter)	.29	.24	.19	.21	.20	.18	.18	.18	.19	.18	.17

LEMON

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curred. With the growth in frozen concentrated lemonade and canned single-strength lemon juice, the products outlet is now made up of a larger proportion of high-value products. It is due to these higher valued products that grower returns from processed lemons attained the relatively favorable levels in some of the recent years. At the same time, there was generated a degree of consumption competition between the fresh lemon and juice products markets. As a result, there arose a different type of problem with respect to allocation of the crop among the fresh and products outlets. Previously, the two outlets were substantially independent in consumption demand; but now the two outlets have become significantly if not completely interdependent in consumption demand.

*Consumption competition may be il*lustrated by the demand for fresh lemons for homemade lemonade and that for frozen concentrated lemonade. From the view of the household consumer and in terms of current retail prices, lemonade made from fresh lemons and lemonade made from frozen concentrate cost about the same on an equivalent quart of lemonade basis. Further, for many consumers the frozen concentrated lemonade provides use conveniences sought by contemporary home managers. The same applies to canned single-strength lemon juice, because the household cost is currently extremely favorable in terms of cents per ounce of lemon juice compared with fresh home-squeezed juice.

Products Marketing Order

The federal marketing order for fresh lemon shipments was utilized to regulate *the flow of fresh lemons from the* California-Arizona producing areas to the receiving markets. Similarly, the California state marketing order for lemon products was introduced with the regulation of the manufacture and flow of juice products into trade and consumption channels as one of its major objectives. However, it also directly affects prices and returns from processed lemons. In the majority of the years since 1950—with important exceptions—the available supply of California lemons for processing, was more than adequate to provide product packs which would be absorbed by the market without substantially depressing the price for juice products.

The products order was intended to equalize the burden of surplus lemons for products or to cushion price breaks in lemon-juice products. The order was framed with the implication that—since the dominant source of supply was from

California lemons—the order could provide a mechanism for controlling the supply pressure of juice products. Significant leakages from supply sources outside of California apparently were not fully envisaged. The importation of lemon stock for the domestic manufacture of juice products has tended to increase and—because of the increased value of processing lemons—areas in the United States that had not produced lemons previously became potential suppliers.

As the state marketing order has been operating in most years, a price floor has been established for California lemons processed into juice products. In addition, the order has indirectly afforded price protection to such competing areas as Italy, Florida, and Arizona, where growers enjoy lower lemon-producing cost structures than do most growers in California.

Interlocking Markets

These developments not only bear upon the lemon-juice products market but also on the fresh lemon market because of the consumption competition between the two markets. Further, as juice supplies originating outside California assume increasing volume, there develops a relatively restricted market outlet of value for California lemons for juice products.

The current situation in which the California lemon industry operates—in conjunction with potential developments —emphasizes the importance of considering the fresh and processed markets and their respective marketing orders as closely interrelated dimensions of an essentially single economic market.

The California lemon industry faces the problem of developing an integrated system of operating that is oriented toward the dynamic economic setting in which the industry finds itself.

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This series of five articles will be available as a reprint early in 1957, and may be obtained without cost by addressing a request to The Giannini Foundation of Agricultural Economics, 207 Giannini Hall, University of California, Berkeley 4.

ISOTOPES

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made in the center of Australia, as far from the sea as possible and where the situation was not complicated by coal burning industrial operations. There, in cloudless clear weather, the highest activities in these experiments were recorded.

The air was generally calm at night so the sampling program was changed to separate the catches made in daytime from those at night. The fraction of lead^{212} accumulated during 10 hours or more proved to be in the neighborhood of half of the total activity. The data point to the conclusion that calm weather in inland areas tends to produce high burdens of atmospheric radioactivity. Yet the high proportion of lead^{212} could not be attributed to industrial activities, so it was postulated that its parent isotope—thoron—was delivered continuously from the soils to the atmosphere. To test this assumption, a plot of soil 18″ × 40″ was dug over and covered by a galvanized iron lid leaving one end open and placing the filter at the other end. The rate of air flow was arranged so the air traveled over the 40″ path of loosened soil in a period of two minutes before passing through the filter. If thoron were to escape from the soil, its half life of 54.5 seconds should allow a considerable proportion of it to be converted to polonium^{216}—0.14 second half life—and thence to lead^{212}. Even though it is assumed that radon also diffused from the soil its half life of 3.8 days would require that most of the gas should pass on through the filter without disintegrating to lead^{214}. For comparison a parallel filter was run filtering the same quantity of air from the open atmosphere. It was demonstrated that air in close contact with loosened soil accumulated considerably more activity and the higher proportion of this activity was due to the presence of lead^{212} derived from thorium decay.

Samples of 120 different soils representative of the great soil types of the world were examined and radon was found to be an important component of all of the soil atmospheres.

In the absence of any direct information on health hazard features from natural radioactivity in the atmosphere, a test was conducted with a sheep. On the 20th and 21st of April 1955, two record high counts of radioactive lead^{212}—444 and 417 counts per minute—were measured. On the second day of high activity a sheep which had been penned for two weeks close to the site of measurement was slaughtered and its respiratory organs examined.

From the lead isotopes recovered from the sheep's lungs it was concluded that approximately 18% of the lead^{212} inhaled by the sheep during the preceding 24 hours was retained in the respiratory system. Unfortunately this experiment could not show where the balance of the activity had gone. It may have been returned to the atmosphere, or it may have been distributed throughout the body.

The steady intake of lead^{214}, which decays to lead^{210} with a 22 year half life, may be retained by the body. Lead^{210} would accumulate and reach half its maximal value in 22 years, 75% in 44 years, and 87½% in 66 years.

The principal findings of this series of investigations are that radioactivity is always present in the atmosphere in the form of decay products of uranium and thorium and that the short-lived thoron—54.5 second half life—and its daughter products assume equal importance with those of radon.

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METABOLITES

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soak period, storage, and growth in soil after treatment are currently under study. The multiple effects of the gibberellins on dormancy, growth, flowering, and fruiting suggest a critical study of their effects on dormancy of pome fruit seeds as well as on dormancy, growth, fruit set and development of pomological crops.

Although the results of these studies are highly suggestive, the practical significance of the gibberellins as agricultural chemicals requires extensive evaluation.

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C. A. West, B. O. Phinney and Anton Lang of the University of California, Los Angeles, and S. H. Wittwer and M. J. Bukovac of Michigan State University conducted the additional research on gibberellins referred to in the above article.

Dr. F. D. Stodola, Northern Utilization Research Branch, USDA, Peoria, Illinois, supplied the gibberellins used in these studies.

The above progress report is based on Project 1175 D.

CLOVER

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Plants receiving 300 pounds of superphosphate produced twelve times as much clover and contained 0.157% phosphorus. They were clearly deficient since more applied phosphorus gave a large additional yield increase.

Clover from the 600-pound treatment produced 94% of the maximum yield and contained 0.190% total phosphorus. Further application of fertilizer in the 1,200-pound treatment caused no significant increase in yield, though phosphorus content did increase.

At the control and at the low rates of application the phosphorus content curve follows the yield increase. The yield approached maximum with the 600-pound

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