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WM. A. TAYLOR, Chief

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June 25, 1920

CITRUS-FRUIT IMPROVEMENT  
A STUDY OF BUD VARIATION IN THE  
EUREKA LEMON

By

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and Pomological Investigations

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**CITRUS-FRUIT IMPROVEMENT: A STUDY OF BUD VARIATION IN THE EUREKA LEMON.<sup>1</sup>**

By A. D. SHAMEL, *Physiologist*, L. B. SCOTT, *Pomologist*, C. S. POMEROY, *Assistant Pomologist*, and C. L. DYER, *Scientific Assistant*, *Fruit-Improvement Investigations, Office of Horticultural and Pomological Investigations.*

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**IMPORTANCE OF THE LEMON INDUSTRY.**

The lemon (*Citrus limonia* Osbeck), as grown in the United States, is largely a California product. According to the Thirteenth Census of the United States there were 957,000 lemon trees of bearing age in the United States in 1910 and 396,000 under bearing age, of which 941,293 and 379,676, respectively, were in California. The total production of all States in 1909 was reported as amounting to 2,770,313 boxes, of which California produced 2,756,221 boxes.

<sup>1</sup> This is the fourth in a series of bulletins summarizing the citrus fruit-improvement investigations of the Department of Agriculture. The three former reports, U. S. Dept. Agr. Buls. 623, 624, and 697, presented the results of studies with the Washington Navel orange, the Valencia orange, and the Marsh grapefruit, respectively. A report on bud variations in the Lisbon lemon will be found in U. S. Department of Agriculture Bulletin 815, entitled "Citrus-Fruit Improvement: A Study of Bud Variation in the Lisbon Lemon."

The commercial development of the lemon industry in the United States is of comparatively recent date. The total production in 1899 was 877,000 boxes as compared with 2,770,000 boxes in 1909, an increase of 215.9 per cent. The rapidity of the development of lemon production in California is shown in Table I.

TABLE I.—*Shipment of lemons from California,<sup>a</sup> for the 32-year period from 1887 to 1918, inclusive.*

Year ending. Oct. 31.	Car-loads. <sup>b</sup>	Year ending Oct. 31.	Car-loads. <sup>b</sup>	Year ending Oct. 31.	Car-loads. <sup>b</sup>	Year ending Oct. 31.	Car-loads. <sup>b</sup>
1887.....	12	1895.....	335	1903.....	2,649	1911.....	6,891
1888.....	20	1896.....	565	1904.....	2,782	1912.....	6,133
1889.....	26	1897.....	1,378	1905.....	4,274	1913.....	c 2,304
1890.....	34	1898.....	1,166	1906.....	3,789	1914.....	c 3,032
1891.....	40	1899.....	903	1907.....	3,507	1915.....	7,068
1892.....	52	1900.....	1,447	1908.....	4,959	1916.....	7,186
1893.....	65	1901.....	2,924	1909.....	6,196	1917.....	7,915
1894.....	145	1902.....	2,816	1910.....	4,891	1918.....	d 6,337

<sup>a</sup> Wallschlaeger, F. O. The world's production and commerce in citrus fruits and their by-products. Citrus Prot. League, Cal., Bul. 11, p. 69. 1914. Data from 1914 to 1918 furnished by the California Fruit Growers' Exchange.

<sup>b</sup> The average number of boxes per car for lemons has varied from 310 to 390.

<sup>c</sup> Crops of 1913 and 1914 reduced by frosts.

<sup>d</sup> Crop of 1918 reduced by extreme heat in 1917.

The lemon acreage in the counties of California where this industry is most important and the production in the leading counties in 1917 are shown in Table II, which also shows the location of the principal lemon districts in the State.

TABLE II.—*Acreage and fruit production of lemon trees in the principal lemon-producing counties of California, in 1917.<sup>a</sup>*

Counties.	Acreage, 1917.		Production, 1917.	Counties.	Acreage, 1917.		Production, 1917.
	Bearing.	Non-bearing.			Bearing.	Non-bearing.	
Los Angeles.....	3,801	1,270	<i>Pounds.</i> 85,520,000	Tulare.....	1,132	1,534	4,160,000
Orange.....	4,000	2,300	23,400,000	Ventura.....	2,327	3,980	32,768,000
Riverside.....	3,137	2,395	27,448,000	All others.....	364	1,300	132,000
San Bernardino.....	3,549	2,850	31,954,000	Total.....	22,451	17,940	236,966,000
San Diego.....	3,126	2,071	17,584,000				
Santa Barbara.....	1,015	240	14,000,000				

<sup>a</sup> Compiled from the reports of the County Horticultural Commissioners by Geo. P. Weldon, Chief Deputy and O. W. Newman, Assistant Secretary, State Commission of Horticulture.

Some idea of the extent to which California is supplying the market requirements for lemons in the United States may be gained by referring to Table III, which presents a comparison of all the imports of lemons into the United States, except from Cuba, and the shipment of California lemons.

The Eureka, Lisbon, and Villa Franca are the important varieties of lemons grown in California. The Eureka variety is the most widely grown. The Lisbon variety is extensively grown in certain districts, particularly those near the coast, and its trees are being

planted in increasing numbers. The Villa Franca variety was used extensively during the early period of commercial lemon planting, but at the present time its propagation has been almost abandoned.

TABLE III.—Imports of lemons into the United States compared with lemon shipments from California, for the 19-year period from 1900 to 1918, inclusive.

Year.	Imports. <sup>a</sup>	Shipments from California. <sup>b</sup>	Year.	Imports. <sup>a</sup>	Shipments from California. <sup>b</sup>	Year.	Imports. <sup>a</sup>	Shipments from California. <sup>b</sup>
	<i>Pounds.</i>	<i>Pounds.</i>		<i>Pounds.</i>	<i>Pounds.</i>		<i>Pounds.</i>	<i>Pounds.</i>
1900...	160,198,056	43,410,000	1907...	157,859,906	105,210,000	1913...	151,416,412	c 69,120,000
1901...	148,514,614	87,720,000	1908...	178,490,003	148,770,000	1914...	58,019,405	c 90,960,000
1902...	164,075,309	84,480,000	1909...	135,183,550	185,880,000	1915...		c 212,040,000
1903...	152,004,213	79,470,000	1910...	160,214,785	146,730,000	1916...	(d)	c 215,580,000
1904...	171,923,221	83,460,000	1911...	134,968,924	206,730,000	1917...		c 237,450,000
1905...	139,084,321	128,220,000	1912...	145,639,396	183,990,000	1918...		c 190,110,000
1906...	138,717,252	113,670,000						

<sup>a</sup> Years ending June 30. Figures from the Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce.  
<sup>b</sup> Years ending October 31. Figures from the California Fruit Growers' Exchange.  
<sup>c</sup> Crops of 1913 and 1914 reduced by frosts.  
<sup>d</sup> Imports from 1915 to 1918 are expressed in values rather than pounds and for this reason are not here presented.  
<sup>e</sup> Crop of 1918 reduced by extreme heat in 1917.

**HISTORY OF THE EUREKA VARIETY.**

The Eureka variety originated in Los Angeles, Calif. In 1858 Dr. Halsey, a physician of that city, received from New York City a box of Sicilian lemons. From seeds of these fruits he grew a number of trees in a small nursery which he owned on Alameda Street, Los Angeles, near the present site of the Southern Pacific Railroad depot. In 1860 Mr. Andrew Boyle purchased from Dr. Halsey several hundred of these seedling trees. They bore very lightly until 1870 and 1871, at which time three or four of them were found to produce smooth, thin-skinned fruits very different from the thick-skinned and coarse-textured fruits produced by the other trees. In 1877 Mr. W. H. Workman, son-in-law of Mr. Boyle, gave to Mr. Thomas A. Garey, a prominent horticulturist of Los Angeles, buds taken from one of the seedling trees which was bearing smooth, thin-skinned lemons.<sup>1</sup> Mr. Garey propagated these buds, and the trees grown from them were found to bear lemons of superior quality. A large stock of the trees of this variety was then grown and distributed under the name of Garey's Eureka.<sup>2</sup> Later, by common consent, the name of the variety was shortened to Eureka, under which name it is now generally propagated and grown.

**VARIABILITY WITHIN THE VARIETY.**

The systematic studies of the variations of the California citrus varieties were begun with the Washington Navel orange in 1909. While carrying on studies of the variations of the Marsh grapefruit,

<sup>1</sup> Personal statement of Mr. W. H. Workman, 310 Washington Building, Los Angeles, Calif., March 21, 1917.  
<sup>2</sup> Letter from Mr. A. T. Garey, son of Mr. Thomas A. Garey, 200 West 47th Street, Los Angeles, Calif., March 19, 1917.

the striking variability of Eureka lemon trees in a neighboring orchard was discovered. This orchard consisted of about 16,000 trees which were six years old at that time. The buds from which the trees had been propagated were obtained from a well-known productive Eureka orchard in the same locality. The buds were procured in the customary way, two men having been sent to cut them with no thought of selection from superior individual trees.



FIG. 1.—A typical lemon tree of the Eureka strain, 10 years planted. All of its branches are bearing flowers or fruits in various stages of development.

The usual habit of growth of the productive Eureka trees under observation was open and somewhat drooping (fig. 1), and the trees had medium-sized leaves which were oval and rounded in shape. The fruitful trees were bearing heavy crops of fruit during June, 1911, and every branch was apparently carrying blossoms and lemons in varying stages of development.

However, here and there trees were observed having a very different habit of growth and condition of fruitfulness. These trees had a spreading habit of growth with large and sharply pointed leaves and

few blossoms or fruits. The fruits were usually ridged, rough in texture, with very thick peel and very little juice (Pl. II), in striking contrast with the smooth, very juicy, and thin-skinned (Pl. I) lemons borne by most of the trees. The unproductive trees were usually much larger than the productive ones, and the foliage was characteristically more dense and abundant. For these reasons they were commonly called shade trees.

The differences in tree and fruit characteristics of the two types of trees were so distinct and marked that typical trees of each strain could be determined at a glance and from a considerable distance.

A careful individual-tree census of the 16,000 lemon trees in this orchard was made during June and July, 1911. As a result, 2,200 trees, or 14 per cent, were found to have typical characteristics of the Shade-Tree strain. Furthermore, the systematic study of the trees revealed the presence of other undesirable strains not noticed at first.

In order to throw some light, if possible, upon the large proportion of unproductive trees in this orchard, an individual-tree census was made of the parent orchard from which the buds had been procured. It was found that in the parent orchard only 5 per cent of the total number of trees were of the Shade-Tree strain. The explanation of this condition was found to be that the bud cutters found it easier to secure bud wood from the vigorous vegetative shade trees than from the less vigorous growing productive trees. There were many more vegetative branches, then commonly used for propagation, in the shade trees than in the productive trees. Consequently, without careful individual-tree selection based on performance records, the bud cutters naturally secured more bud wood from the shade trees than from the productive trees.

Characteristic differences in the trees of the several strains of the Eureka lemon variety were found to exist not only as shown by the habit of growth, the amount and the commercial quality of the fruits, the density and other characteristics of the foliage, but also in the season of production of the fruits, the number and size of thorns, the number, size, and shape of the seeds contained in the fruits, the structure of the flowers, and the variability of the fruits.

Tree-census studies in many Eureka lemon orchards have revealed the fact that the variety is made up of a number of diverse strains arising from the propagation of striking bud variations. This condition of variability is important commercially, from the fact that the production of some of the strains is small and of very inferior quality, while other strains bear their crops during the late fall or very early spring when low lemon prices are the rule, making the crops of inferior value.

In these studies detailed performance records have been obtained on a total of 252 Eureka<sup>1</sup> lemon trees in the investigational plats. The individual trees in these plats have been picked monthly as far as possible. The frequent pickings and the resulting large amount of detailed work in assorting, classifying, counting, weighing, and recording the yields has made it necessary to limit to a comparatively small number the trees selected for individual-tree performance-record studies. The many pickings during a period of several consecutive years have resulted in the accumulation of a very large mass of data and information, from which conclusions have been drawn as to varietal, strain, and individual-tree characteristics.

In addition to these detailed studies, cooperative individual-tree performance records have been carried on in several California lemon orchards during this period with about 14,000 trees of the Eureka variety.

The variability of the Eureka lemon described in the discussion of the results of these studies, due to bud variations, must be clearly distinguished from the fluctuating variability due to climatic, soil, cultural, or other environmental influences. The variations considered in these studies are those which have been found to be inherent and transmitted by budding. The fluctuating variations, such as modifications of the size of the fruits, slight differences in the color of the leaves or fruits, and similar changes due to climatic conditions, cultural factors, or other causes, have not been taken into account except as indicating the effect of certain environmental factors in tree and fruit development. All of the variations considered in these studies have been traced to individual fruit or limb variations in trees growing under normal conditions.

#### OBJECTS OF THE INVESTIGATIONS.

The objects of these investigations have been to determine the frequency and importance of bud variations in lemon trees of the Eureka variety; to ascertain the relative value for commercial orcharding of the various strains originating from bud variations; to discover methods for isolating the best and eliminating the inferior strains through bud selection; to originate and introduce methods for replacing trees of inferior strains in established orchards through top-working or replanting; to introduce methods for obtaining reliable supplies of buds from superior performance-record trees for use by propagators; and to establish a system of individual-tree record keeping in commercial lemon orchards, in order to locate the desirable and undesirable trees.

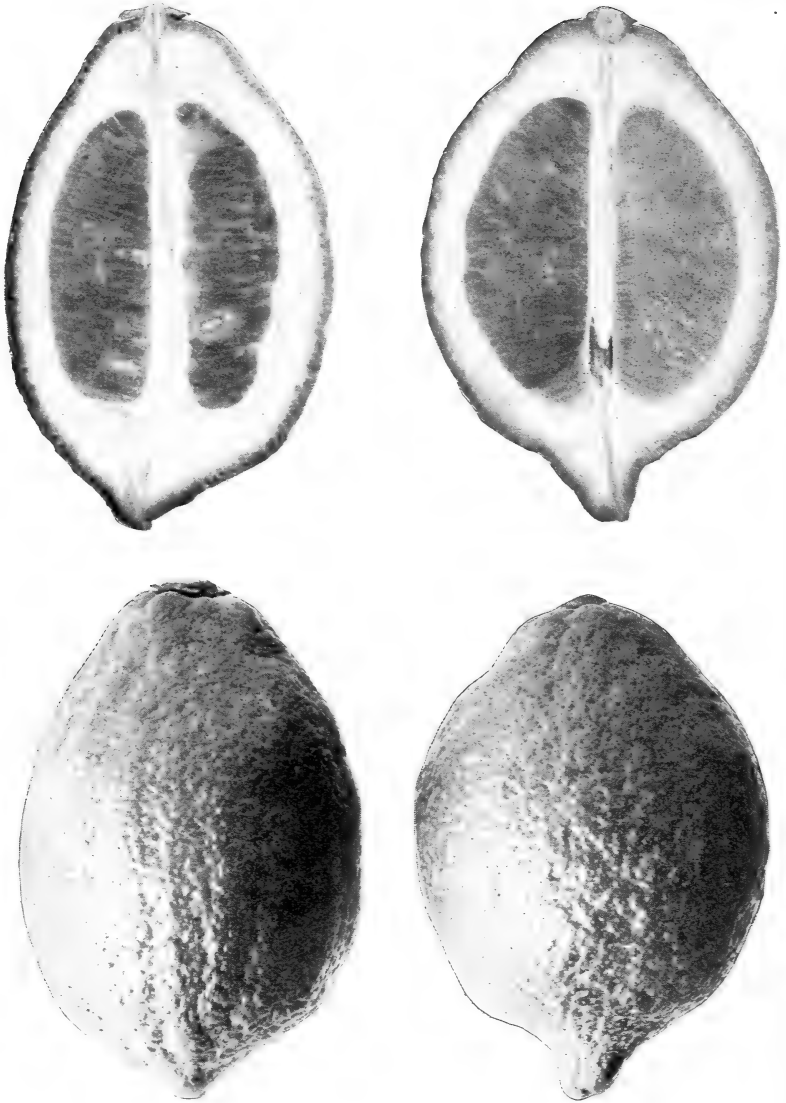
<sup>1</sup>A report on variations in the Lisbon variety will be found in Department of Agriculture Bulletin No. 815, entitled "Citrus-Fruit Improvement: A Study of Bud Variation in the Lisbon Lemon."



TYPICAL LEMON FRUITS OF THE EUREKA STRAIN OF THE EUREKA VARIETY.

All the specimens here illustrated, including the cross section, the axial section, and entire fruit, were fresh, unpeeled samples. Natural size.





**TWO TYPICAL LEMON FRUITS OF THE SHADE-TREE STRAIN OF THE EUREKA VARIETY.**

The long shape, coarse texture, and thick rinds of these fruits make them of inferior commercial value. About three-fourths natural size.



## PLAN OF THE INVESTIGATIONS.

These investigations have been carried on by means of individual-tree performance records. The term "performance record" is here used to mean a systematic record for a period of several years of the yield and behavior of individual trees. This record includes accurate notes of the number, the commercial quality, and the variability and other characteristics of the fruits produced by the individual trees. It is usually accompanied by descriptive notes and photographs, or drawings, showing the characteristics of the habit of growth, the leaves and flowers, and the position or arrangement of the fruits on the trees. Individual-tree performance records for at least two consecutive and normal seasons on lemon trees which have reached full bearing age are considered necessary in order to determine the value of the trees for commercial fruit production. Similar records for at least four years are advisable, in order to furnish an adequate basis for the selection of superior trees as sources of bud wood for propagation.

The performance records presented in this bulletin have been made from full-bearing trees located in successful commercial orchards where the conditions have been particularly favorable for comparative individual-tree studies. It has been possible to compile these records only through the hearty cooperation of the owners of the orchards selected for study. The picking of the fruits has usually been done by members of the regular picking crew. The assorting, weighing, and counting have been done by the writers in the orchards immediately after the fruits have been picked. The crops of fruit, after the records have been finished, have been turned in with the crop from the orchard as a whole, except such specimens as have been needed for further study. Owing to the additional handling necessary for the classification of the fruits, particular care has been used in order to avoid as far as possible all mechanical injuries, which frequently lead to decay and consequent loss to the growers.

The conditions considered in the location of the individual-tree performance-record plats were as follows: (1) The production of successful and profitable crops of fruit; (2) location on virgin land, in order to avoid any influence of previous cultural treatments; (3) protection from cold, strong winds, or other climatic causes of tree and fruit injuries; (4) the absence of radical pruning, rebudding, top-working, or other similar tree treatments; (5) freedom from or the effective control of diseases and insect pests; (6) uniform irrigation and cultural practices during the entire history of the orchard; (7) reliable information concerning the history of the buds used in the propagation of the trees and the kind of stocks; (8) the prospect of settled ownership for a period of years; and (9) the absence of apparent local environmental factors influencing tree behavior, in

order that the results of the individual-tree studies might be truly comparative.

As a result of experience in similar work with other varieties, the performance-record plats of Eureka lemons were located so that they included representative trees of several important strains. The records of the performance of these typical trees constitute the basis for comparing the production of the different strains and their value for commercial orcharding.

The original plat included 105 trees. Later, additional trees representing important strains were added, in order to secure as complete information as possible concerning the variability of the strains. By the selection of plats in uniform soil areas and in sections with the same altitude, like exposure, and comparative drainage conditions, it is believed that the results obtained are less affected by fluctuations due to variations in soil fertility, soil moisture, and other environmental factors than would be the case if the records of all of the trees in the orchards were used for comparison.

#### METHODS OF KEEPING PERFORMANCE RECORDS.

The methods of keeping the individual-tree performance records in the lemon plats were adopted as a result of the experience gained during the preceding similar study of orange and grapefruit trees.

These methods involve more detailed observations than is usually considered necessary in commercial-orchard practice. A modification of these methods, adapting them for regular lemon-tree record keeping, is described in Farmers' Bulletin 794, entitled "Citrus-Fruit Improvement: How to Secure and Use Tree-Performance Records."

#### TREE NUMBERS.

The individual lemon trees were given numbers so that the data obtained from the study of each tree could be kept separate during the entire period of observation. Each number consists of three parts—the number of the block in which the tree occurs, the number of the row in the block, counting from some fixed point (as, for example, the irrigation head), and the number of trees in the row. Where several different orchards are under observation, the tree number is preceded by the name of the orchard or an abbreviation indicating it.

In the case of bearing trees it is most desirable to paint the number on the tree trunk or on one of the main limbs. The figures should be large and plain, so as to be readily identified from some distance. Ordinary white-lead paint and a small brush are the materials used for tree numbering. The numbers, when properly applied, have remained in a satisfactory condition for six or seven years. Where it is desirable to number small trees, the number may be stamped on a metal tag, or painted on a wooden label, and attached to one of the branches. The numbers should always be placed in the same relative position on all of the trees, so that they can easily be found.

## PICKING.

The fruits borne by the trees in the performance-record plats were picked when reaching a certain size, as determined with the aid of metal picking rings, using each month a ring of the same size as that used by the regular picking crew in the orchard. While the sizes of rings varied somewhat with different pickings, all of the fruits of each picking were measured with a ring of the same size, so that the pickings from the individual trees were comparable. Particular care was taken that no mixing or loss of fruits from the individual trees occurred. The fruits from all the trees picked during the day were studied the same day, after which they were sent to the packing house to be included with the remainder of the crop. The clippers used by the pickers, the picking sacks, and the field boxes were all regularly inspected, in order to prevent as far as possible mechanical injuries to the fruits, which frequently lead to decay. Every effort was made to arrange the picking and handling of the fruits from the performance-record trees so as to cause the least possible inconvenience and loss to the owners of the orchards.

## ASSORTING.

The lemons from each of the performance-record trees at each picking were assorted into three grades, viz, Green, Tree-Ripe, and Cull. In the Green grade both the light and dark green fruits were included; the Tree-Ripe grade included the yellow ripe fruits, and the Cull grade included unmerchantable lemons. The Green grade was made up of the valuable commercial fruits. The Tree-Ripe grade was made up of mature or prematurely ripened fruits, usually of small size with thin rinds and an abundance of juice which was lacking in acidity. Fruits of the Cull grade were frequently extremely coarse, rough, or malformed, rendering them unfit for the market. Fruit which dropped to the ground between picking periods was also included in the Cull grade.

After the fruits from each tree were assorted, each lot was weighed and the number of lemons counted. These data were recorded in the field-note forms, as shown in Table IV.

The variable fruits in each picking from each tree were sorted and classified, after the other performance-record data had been recorded. Frequently, samples of fruits were saved for photographing or for special studies. In some cases photographs and notes of the trees were taken, showing their habits of growth, the characteristics of the foliage or flowers, and other phases of tree behavior.

At the time of each picking, one fruit of the Green grade, one of the Tree-Ripe grade, and one of the Cull grade were selected from the crop of each tree and examined for seeds. The fruits were cut, the seeds carefully removed, counted, dried, and reserved for further study.

In the event that any samples of fruits of any of the grades were missing, so that the seeds could not be counted, a statement of this fact was made in the note form by using the words "Not counted." Figure 2 shows the simple equipment used in making individual-tree performance records and the method of handling it.

TABLE IV.—Forms for field use in investigational work for making individual-tree performance records, showing the data from four lemon trees of the Eureka variety on the Chase plantation for the picking in April, 1916.

[Horticultural and Pomological Investigations, B. P. I. form 110 B. Space is provided for recording the gross, tare, and net weights, or for the data for two boxes of fruit separately for each tree. These four trees are listed in ranks 105, 35, 82, and 34, respectively, in Table VI and in figure 9. The record for tree 34-75-16 for the season of 1915-16 is shown in Table V, and its record for six seasons is tabulated in rank 35 in Table VIII.]

A.—Front of sheet, showing the form for recording the weight and number of the fruits of the different grades and the number of seeds in three typical fruits from each tree.

Grove, Chase plantation, Plat, 34. Row, 75. Date, April 23, 1916. Variety, Eureka.

Tree No.	Fruits.								Seeds.		
	Green grade..		Tree-Ripe grade.		Cull grade.		Total crops.		Green grade.	Tree-Ripe grade.	Cull grade.
	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.			
34-75-15.....	$\left. \begin{array}{l} \text{Lbs. oz.} \\ 22-15 \\ \text{a}11-15 \\ 11-0 \end{array} \right\}$	38	$\left. \begin{array}{l} \text{Lbs. oz.} \\ 0-12 \end{array} \right\}$	3	$\left. \begin{array}{l} \text{Lbs. oz.} \\ 0-4 \end{array} \right\}$	2	$\left. \begin{array}{l} \text{Lbs. oz.} \\ 12-0 \end{array} \right\}$	43	5	0	5
34-75-16.....	$\left. \begin{array}{l} 55-3 \\ \text{a}15-10 \\ 39-9 \end{array} \right\}$	145	3-1	13	1-2	7	43-12	165	17	5	10
34-75-17.....	$\left. \begin{array}{l} 36-8 \\ \text{a}16-5 \\ 20-3 \end{array} \right\}$	78	2-5	10	2-10	16	25-2	104	17	11	9
34-75-18.....	$\left. \begin{array}{l} 24-5 \\ 40-0 \\ 64-5 \end{array} \right\}$	$\left. \begin{array}{l} 86 \\ 148 \end{array} \right\}$	6-12	28	1-7	10	72-8	272	21	21	10

B.—Back of sheet, showing the form for recording the variable fruits found on the trees.

Variable fruits.	Tree.				Variable fruits.	Tree.			
	15	16	17	18		15	16	17	18
Collared.....	8	9	.....	3	Ridged, collared, and protruding.....				
Collared and protruding.....					Sunken section.....				
Protruding blossom end.....					Creased.....				
Bottle shape.....					Split.....				
Raised section.....					Abnormal shape.....				
Raised ridge.....					Brown-rot.....				
Ridged.....		7	3	17	Sunburn.....				
Ridged and collared.....	1								
Ridged and protruding.....									

<sup>a</sup> Tare to be deducted from total weight.

In some cases, in order to study the fruits after curing, the crops from each tree were kept separate and stored in the packing house for a period of six weeks to two months. After curing, the lemons were

again assorted and classified according to their condition and appearance. These studies were made for the purpose of correlating the condition of the freshly picked with that of the cured fruits. During storage the atmospheric conditions in the curing room were maintained as nearly as possible at 70° F. and at 90 per cent relative humidity.

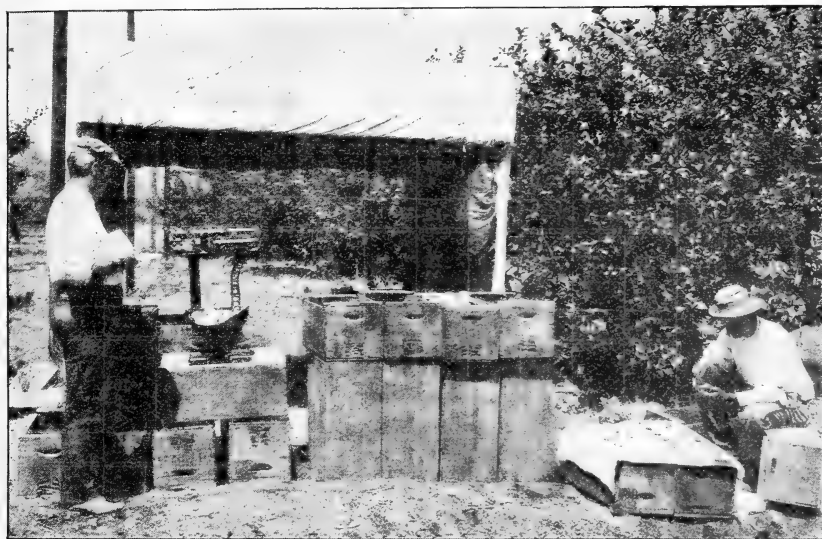


FIG. 2.—Shelter and apparatus used in obtaining performance-record data from lemon trees. The fruit and equipment apparatus were moved out of the shelter temporarily in order to take the photograph used for this illustration.

#### RECORDING THE DATA.

The data obtained from the study of the fruits picked from each tree at each picking were recorded in special field-note forms, as shown in Table IV. In addition to these data, other notes concerning the individual-tree behavior were made from time to time. As soon as possible after each picking the individual-tree data were transferred to forms providing for a maximum of twelve pickings, or monthly pickings for one year, as shown in Table V. When the complete record for an entire year had been obtained, the data showing the total production for the year, together with accompanying observations, were transferred to a form providing for the bringing together of the data on the individual trees for a period of several years, as shown in Table VIII. Photographs of interesting trees, fruits, flowers, and foliage were frequently taken, in order to fix definitely in the records important phases of tree behavior and fruit characteristics.

TABLE V.—Performance record of lemon tree number 34-75-16, Eureka strain, showing the weight and the number of fruits of each grade and the number of seeds per fruit produced each month during the season of 1915-16.

[This record illustrates the form used to assemble the data for each tree for each season. In practice the variable fruits produced by the tree each month are recorded on the back of the form. The weights are given in pounds and ounces. This tree is listed in rank 35 in Tables VI and VIII and in figure 9.]

Date, 1915-16. Variety, Eureka. Strain, Eureka. Grower, National Orange Co. Location, Corona, Calif. Grove, Chase plantation. Plat, 34. Row, 75. Tree, 16.

Character of data.	Date, season of 1915-16.												Total or average.
	July 22.	Aug. 28.	Sept. 24.	Oct. 27.	Nov. 24.	Dec. 22.	Jan. 31.	Mar. 1.	Mar. 24.	Apr. 28.	May 27.	June 29.	
Weight of fruits:													
Green grade.....	2- 7	10-10	16-13	32-11	4-14	3-11	15- 2	19-11	13-14	39- 9	30-10	8- 7	198- 7
Tree-Ripe grade....	3- 0	4-12	4-15	4- 5	14-10	33-11	3-12	1- 6	0- 0	3- 1	33- 4	9- 9	116- 5
Cull grade.....	0- 4	1- 5	1- 0	1-10	1- 4	0- 2	0- 7	0- 7	0-15	1- 2	6-10	10- 8	25-10
Total.....	5-11	16-11	22-12	38-10	20-12	37- 8	19- 5	21- 8	14-13	43-12	70- 8	28- 8	340- 6
Number of fruits:													
Green grade.....	10	39	65	129	19	14	55	73	52	145	121	33	755
Tree-Ripe grade....	14	22	24	21	60	167	28	9	0	13	154	44	556
Cull grade.....	2	9	8	13	8	1	2	3	5	7	41	61	160
Total.....	26	70	97	163	87	182	85	85	57	165	316	138	1,471
Average number of seeds:													
Green grade.....	10	6	7	10	0	0	0	0	12	17	16	4	6.83
Tree-Ripe grade....	8	11	3	3	7	4	5	5	5	5	8	9	6.18
Cull grade.....	7	5	1	5	6	3	3	5	17	10	8	15	7.08
Total.....	25	22	11	18	13	7	8	10	29	32	32	28	6.71
Variable fruits:													
Collared.....	0	0	0	1	1	7	15	17	6	9	16	2	74
Collared and protruding.....	1	0	0	0	2	0	11	12	3	0	0	1	30
Protruding blossom end.....	1	0	2	3	1	0	3	6	7	0	1	0	24
Raised ridge.....	0	0	0	3	0	1	2	0	0	0	2	0	8
Ridged.....	1	0	2	0	0	0	0	0	1	7	9	0	20
Ridged and collared.....	0	0	0	0	0	0	0	0	0	0	2	0	2
Ridged and protruding.....	0	0	0	0	0	0	0	0	1	0	0	0	1
Creased.....	0	0	2	0	0	0	0	1	0	0	0	1	4
Total.....	3	0	6	7	4	8	31	36	18	16	30	4	163

An important consideration in obtaining reliable individual-tree performance records is that the data be obtained and recorded in the field, at first hand, while the observations are fresh and clear. In these studies the notes were made during the actual work of picking and classifying the fruits. It frequently happens that in the selection of parent trees as sources of bud wood or in selecting inferior trees for top-working, the final choice is strongly influenced by notes concerning the tree behavior and characteristics of fruiting. The close observation of tree and fruit characteristics during a considerable period of time results in the development of an intimate tree knowledge, which is invaluable in the work of caring for the individual tree and in drawing conclusions as to the value of individual trees and strains for fruit production.

## DESCRIPTIONS OF THE IMPORTANT STRAINS.

## EUREKA STRAIN.

The Eureka strain is the most productive and valuable in the Eureka variety. It was at first called the Open-Productive strain, and the performance-record data of the trees of this strain were recorded under that name during the entire period of these studies.



FIG. 3.—A typical lemon tree of the Eureka strain, seven years planted, showing how the heavy load of fruit pulls the branches into drooping positions. The characteristic habit of trees of this strain in setting fruits on the ends of the branches can be seen in this illustration.

The name Open Productive was adopted because of the characteristic habit of growth and the heavy production of the trees in this strain. The characteristics of its trees and fruits are typical of those usually thought of in connection with the trees and fruits of the Eureka

variety. For this reason and in the interest of simplicity of nomenclature, the name Open Productive has been dropped and Eureka adopted in its place.

The habit of production of the trees of the Eureka strain in the performance-record plats includes the heavy bearing of high-quality fruits which first set at the ends of the branches, frequently in clusters. As the branches bend down from the weight of the end fruits, others set along the branches in the axils of the leaves until 15 to 20 fruits are sometimes produced by a single branch. The lemons develop in their order from the tip to the base of the branches. The trees have a tendency toward regular production throughout the year, in contrast with the trees of some other strains which tend to bear their crops largely during the fall or the spring or some other limited season. The comparatively heavy production of good commercial lemons regularly throughout all seasons of the year under normal conditions is a very important characteristic of the trees of this strain.

The habit of growth of the trees is open, as shown in figure 1. Usually the fruits first set at the ends of the branches, and as the lemons develop in size and weight the limbs are pulled down in a somewhat drooping position, as shown in figure 3. This condition results in a somewhat open and drooping arrangement of the branches, and, as a result, the trees are opened up to the sun and air. One disadvantage of this habit of tree growth is that the fruits are more likely to be injured by sunburn or extreme climatic conditions than those borne by trees having a dense habit of growth. Few or no suckers are produced by the trees of this strain. The leaves of the trees of the Eureka strain are rather sparse in number, usually of medium size, broadly elliptical and bluntly rounded in shape, with slightly crenate margins and of a deep-green color. The rounded leaves in contrast with the sharply pointed ones of some other strains are a striking and important characteristic of the trees of this strain. The blossoms are perfect, as shown in figure 4, A, and the anthers produce viable pollen. Under normal conditions the trees bloom to some extent at all seasons, but most heavily during the spring and fall months. There is no period of the year when blooms and fruits in various stages of growth are not present.

The typical fruits of the Eureka strain, as shown in Plate I, are oblong in shape, medium in size, with smooth texture, thin rind, tender rag, an abundance of juice, and have an average of about seven seeds. Frequently the fruits are slightly ridged. The flesh of the fruits is usually solid and firm. When cured they have a very smooth, satin-like texture and a light-straw color. The receptacle, or button as it is ordinarily called, is usually raised above the surface of the rind somewhat, so that in picking it is possible to sever the stem close to the button without injuring it or the rind with the clippers. Under



favorable curing conditions, the button remains green in color and firmly attached to the fruit. If the button is cut or injured in picking, it is liable to turn brown and become detached from the fruit during the curing process.

#### SMALL-OPEN STRAIN.

The name Small Open, as applied to this strain, is descriptive of the size of the lemons and the habit of tree growth. The main point of difference between this and the Eureka strain lies in the shape and size of the fruits. In shape the fruits are more nearly globular, and they are smaller in size than the typical fruits of the Eureka strain. The habit of growth of the trees is open, like that of the trees of the Eureka

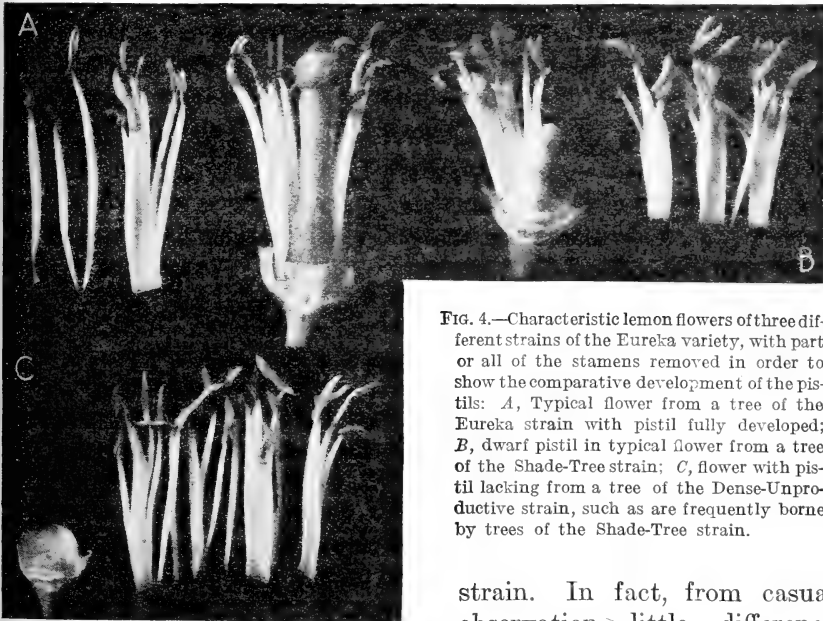


FIG. 4.—Characteristic lemon flowers of three different strains of the Eureka variety, with part or all of the stamens removed in order to show the comparative development of the pistils: *A*, Typical flower from a tree of the Eureka strain with pistil fully developed; *B*, dwarf pistil in typical flower from a tree of the Shade-Tree strain; *C*, flower with pistil lacking from a tree of the Dense-Unproductive strain, such as are frequently borne by trees of the Shade-Tree strain.

strain. In fact, from casual observation little difference can be detected between trees of the two strains, but the difference at once becomes apparent upon close examination of the fruits. Commercially, the difference in the shape of fruits is very important, in that it is much more difficult to make an attractive pack with globular fruits than with the characteristic oblong fruits of the Eureka strain.

The production of the trees of the Small-Open strain in the performance-record plats has been less than that of the trees of the Eureka strain. The season of production is about the same as that of the Eureka strain. The habit of growth is open. The size, shape, number, and color characteristics of the leaves are the same as those of the Eureka strain, so far as observations have been made. The bloom characteristics are very similar to those of the Eureka strain.

The typical fruits are globular, almost spherical in shape, of medium to small size, have a smooth texture, and are without the rather distinct ridges characteristic of fruits of the Eureka strain. They are likely to have a marked depression or crease on the blossom end. The rind is thick, the rag tender, the juice abundant, and the average number of seeds in each fruit is about six.

One of the characteristics of the fruits of this strain develops during curing. As a rule, the fruits cure much more slowly than those of the Eureka strain. The color change takes place very slowly, so that in a lot of fruits of mixed strains it is sometimes necessary to sort out those of the Small-Open strain and retain them in the curing rooms for a longer period than the fruits of some other strains. This condition is unsatisfactory in the handling and curing of lemons, in that it adds to the expense of assorting and delays the packing and shipment of the fruits, while the additional handlings are likely to result in mechanical injuries, which often lead to decay and loss to the growers.

#### SHADE-TREE STRAIN.

The name Shade Tree was adopted for this strain because the trees have a spreading habit of growth, with luxuriant foliage. At certain seasons they have few or no fruits, making them somewhat resemble ornamental trees grown for shade rather than trees cultivated for their fruits.

The production of the trees of the Shade-Tree strain is very much less than those of the Eureka strain, and the fruit is of very inferior commercial quality, from the standpoint of both the fresh and the cured fruits. The production is largely a seasonal one, the main crop being borne during the fall and winter seasons.

In assorting the fruits of the Shade-Tree strain picked in the performance-record studies it was found that an unusual proportion of the lemons was dark green. This condition was found to be due to the fact that the crops of these trees were largely borne during the season when environmental conditions were favorable for the growth of the fruits and from the fact that the crops were very small in comparison with the size of the trees.

In the beginning of these studies the green fruits of the Shade-Tree strain were included in the first or Green grade, because they were green in color. Later studies, not only of the freshly picked fruits but of the cured lemons as well, brought out clearly the inferior quality of the fruits, as shown by their thick rinds, coarse rag, and scant juice. Notwithstanding the discovery of these facts it was decided to continue the classification of the fruits of the Shade-Tree strain under the Green grade because this characteristic is one which can be unmistakably distinguished in the work of assorting the grades in the orchard. It must be kept in mind that in the case of the crops of the Shade-Tree strain the green color is not synonymous with high grade and quality. In fact, the reverse is true, and if the fruits from these trees

had been graded strictly on the basis of the commercial quality of the cured fruits most of them would have been classified as second grade or culls. The results of the studies of the behavior of the fruits of this strain in the curing room emphasizes the importance of this phase of these studies and its desirability in the work of the selection of parent trees as sources of bud wood for propagation.

The habit of growth of the trees is spreading, as shown in figure 5, the main limbs growing in somewhat horizontal positions. Some of



FIG. 5.—A typical lemon tree of the Shade-Tree strain of the Eureka variety, 10 years planted. The trees of this strain grow vigorously and attain great size, but produce only light crops of inferior fruits, which are lacking in juice and acidity.

the branches, particularly the very vigorous growing vegetative ones, or suckers, have an upright habit of growth. The trees of this strain usually develop more suckers than those of the Eureka strain. The general appearance is that of a wide-spreading shade tree. The leaves are usually large, tapering to sharp points, and profuse, and the margins are usually smooth or slightly wavy and have a deep-green color. Frequently the large leaves are acutely pointed at the

tips. The characteristically pointed shape of the leaves often assists in the identification of the trees of this strain.

One of the very important tree characteristics of this strain is the large number of imperfect flowers produced. Usually the blooms are very abundant, but most of them fall from the trees. Investigation of this condition established the fact that many of the flowers are imperfectly developed. Usually the pistils in these imperfect flowers are either rudimentary or absent, as shown in figure 4, *B* and *C*. In either case the flowers fall from the trees soon after opening. Furthermore, the anthers of the perfect flowers have frequently been found to contain very little or no pollen. The pollen grains in many instances apparently have such a low vitality that they either do not germinate or, after germinating, they do not complete the processes of fecundation. For this reason the fruits of this strain usually have but few seeds. The imperfect development of the flowers probably accounts in part for the low production of the trees of this strain, and this characteristic is one by which the trees can frequently be identified.

The fruits borne by the trees of this strain, as shown in Plate II are usually oblong, longer than is the case with fruits of the Eureka strain, of large size, coarse and rough in texture, with a strong tendency to ridging. The rind is normally very thick. The rag is coarse and very abundant; the juice is scant, sometimes being almost entirely absent, poor in quality and lacking in acidity; and the seeds average less than two per fruit. The fruits of this inferior strain are distinctly detrimental in every way to the crops in which they occur.

Tree-census studies in the Eureka lemon orchards in southern California have shown that the number of trees of the Shade-Tree strain varies from 10 to 70 per cent. On the average, 25 per cent of the trees in these orchards were found to be of this strain. These trees, owing to their vigorous vegetative condition, are well adapted to top-working. Performance-record studies of such top-worked trees have shown that under favorable climatic and cultural conditions they can be brought to profitable production of good fruit within three years.

The Shade-Tree strain is one of the most important in the Eureka variety, from the fact that the trees, flowers, and fruits have unmistakable characteristics and also owing to its extensive occurrence in many Eureka orchards. Its elimination in established orchards, through top-working with selected buds from trees of the Eureka strain, will increase and improve the production in many orchards not less than 25 per cent. Its propagation in the future can be avoided largely through bud selection from superior performance-record trees of the Eureka strain.

## DENSE-UNPRODUCTIVE STRAIN.

The trees of the Dense-Unproductive strain are the least productive of any of those of the Eureka variety under observation in the performance-record plats, and the light yield of these trees is coordinated with a correspondingly inferior quality of the fruits. In many ways they resemble the trees of the Shade-Tree strain. The crops of fruit are borne at about the same season, but the habit of growth of the trees, instead of being spreading, is more erect and dense, as shown in figure 6.



FIG. 6.—A typical lemon tree of the Dense-Unproductive strain of the Eureka variety, 10 years planted. The vigorous and dense vegetative characteristics and lack of fruit are very marked.

The trees usually have a large amount of vigorous vegetative growth, or suckers. The leaves are usually not as large as those of the Shade-Tree strain, but in general their shape and color are very similar. The number of leaves produced by the trees of this strain is greater than is the case with the trees of the Shade-Tree strain. The percentage of imperfect flowers of the trees of this strain is larger than in those of the Shade-Tree strain. This abnormal condition of the blossoms is partly responsible for the light yield of fruits of the trees of this strain. The pistils are often small, rudimentary, or

lacking, as is shown in figure 4, *C*. The pollen of the flowers is scant in quantity and of low vitality. This condition accounts for the few seeds found in the fruits, as a rule. Occasionally, in a perfect flower the anthers develop an abundance of viable pollen, in which case the fruits set the normal number of seeds.

The fruits, as shown in Plate III, are oblong, of large size, coarse in texture, and have very thick rinds. The rag is tough and abundant; the juice is scant, of poor flavor, and low acidity; and the fruits have an average of  $2\frac{1}{4}$  seeds.

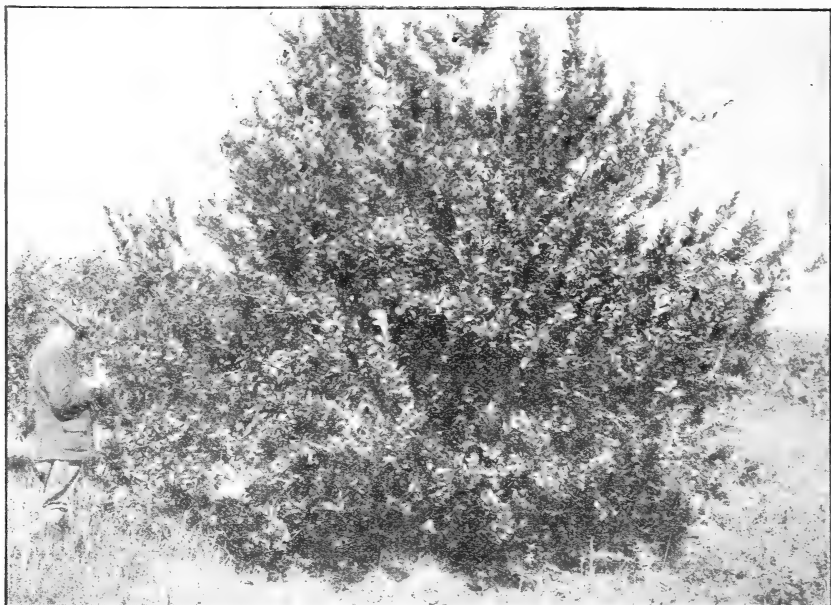
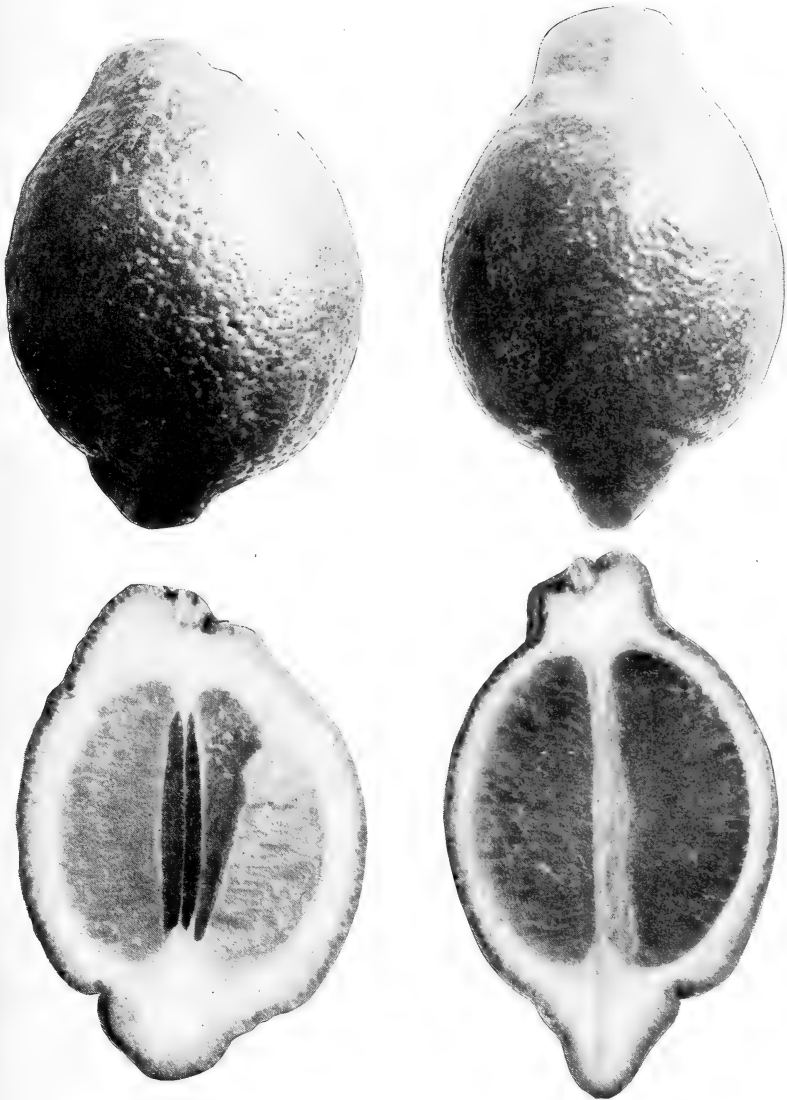


FIG. 7.—A typical lemon tree of the Pear-Shape Eureka strain, 10 years planted. The trees of this strain develop many small branches, giving them a dense appearance. They produce smooth, pear-shaped fruits with long necklike stem ends which are objectionable in packing the fruits for the market.

#### PEAR-SHAPE STRAIN.

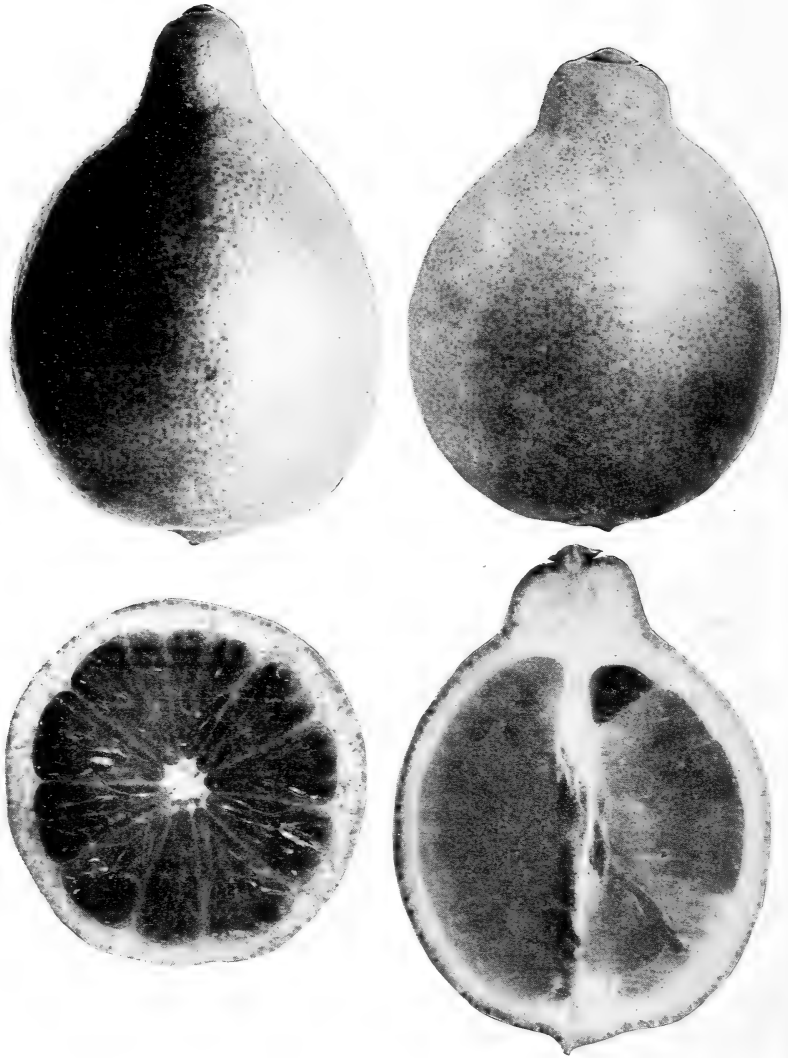
The Pear-Shape strain was given a name descriptive of the shape of the typical fruits. While the trees and fruits differ in many characteristics from those of the other strains, the peculiar shape of the fruits is especially marked. These fruits must be clearly understood to be normal and healthy ones and not the diseased, undeveloped, or misshapen fruits often borne by trees suffering from unfavorable cultural conditions.

The season of production of the fruits by the trees of the Pear-Shape strain is similar to that of trees of the Eureka strain and is more or less regular throughout the year. The yield is usually medium, but on account of the peculiar bottle-like shape of the lemons it is of inferior commercial value.



TWO TYPICAL LEMON FRUITS OF THE DEN E-UNPRODUCTIVE STRAIN OF THE EUREKA VARIETY.

About three-fourths natural size.



TWO TYPICAL LEMON FRUITS OF THE PEAR-SHAPE STRAIN OF THE EUREKA VARIETY.

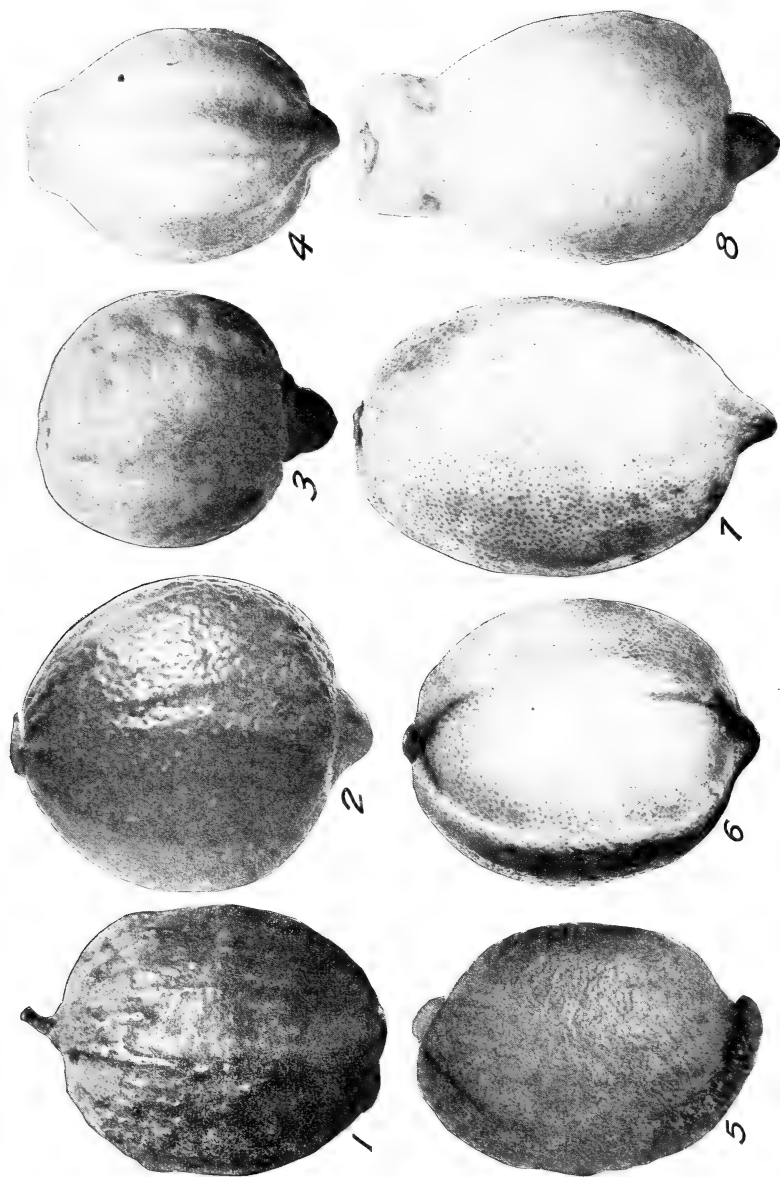
These fruits have smooth texture, long-necked stem ends, and thin rinds, and are poorly adapted for making a good commercial pack. About four-fifths natural size.





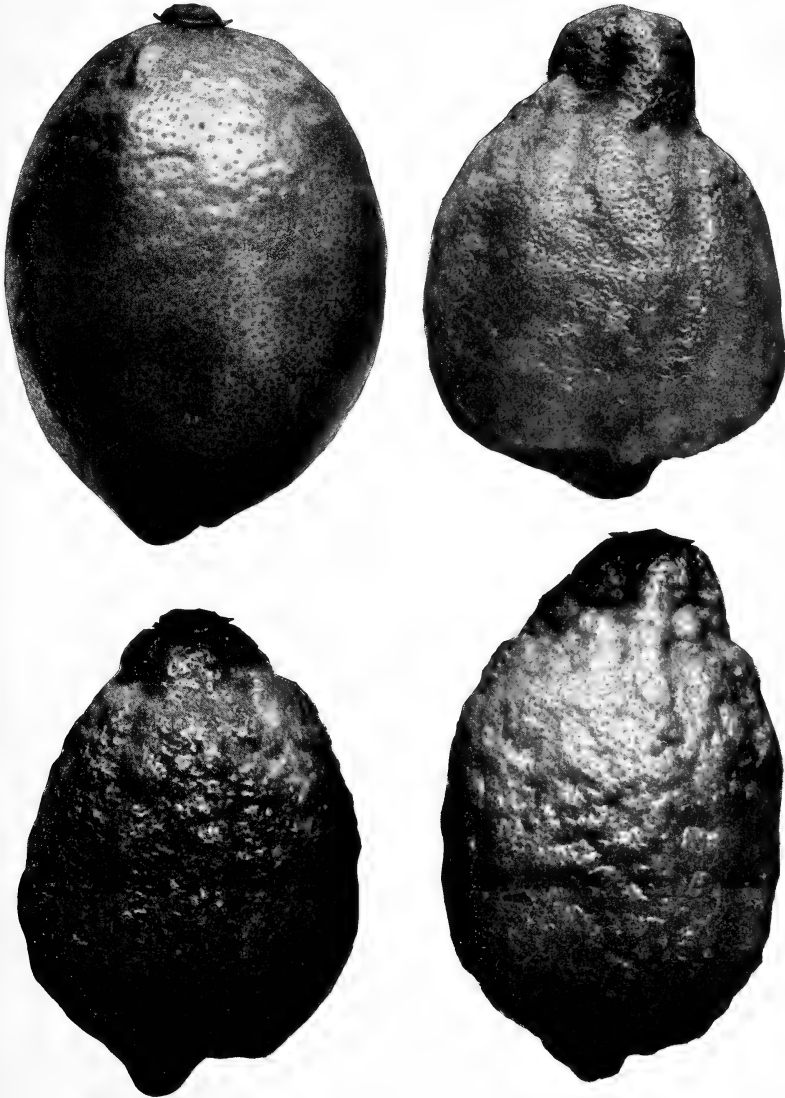
**BRANCHES AND FRUIT FROM A LEMON TREE OF THE VARIEGATED STRAIN OF THE EUREKA VARIETY.**

The characteristic markings on the leaves, fruit, and young wood (see branch at left) are here shown.  
At the right is a twig with leaves which are entirely straw colored, bearing a terminal blossom.



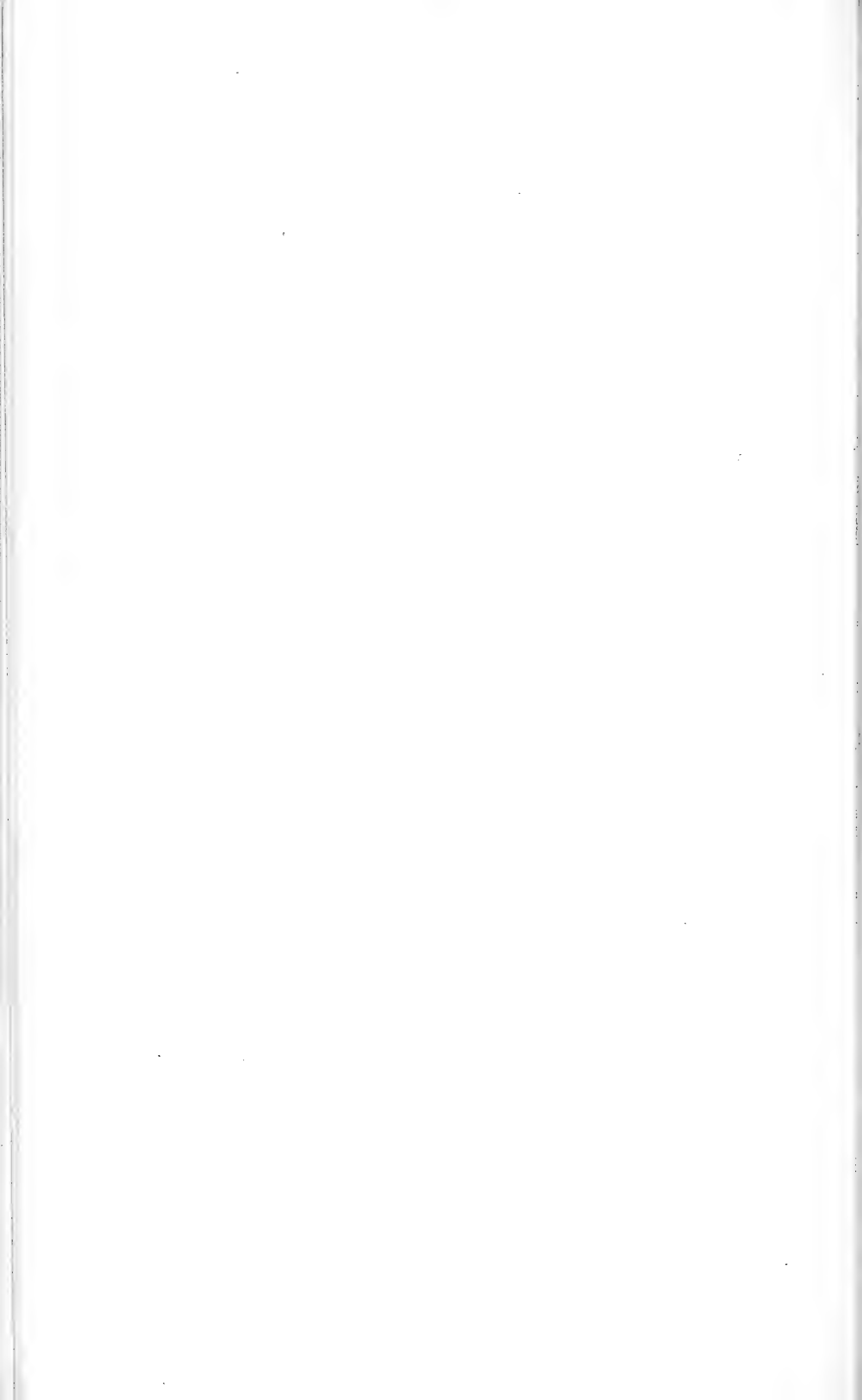
TYPICAL FRUITS FROM A LEMON TREE OF THE SPORTING STRAIN OF THE EUREKA VARIETY.

Variations in shape, texture, and other characteristics are here shown: 1, Corrugated; 2, round, ridged, and protruding blossom end; 3, round, rough, and protruding blossom end; 4, ribbed; 5, ribbed; 6, sunken section; 7, white section; 8, collared and protruding blossom end. About two-thirds natural size.



**A TYPICAL EXAMPLE OF UNDESIRABLE FRUITS BORNE AS LIMB VARIATIONS ON A EUREKA LEMON TREE.**

The three coarse fruits were from two limb sports produced by a tree bearing normal, smooth Eureka lemons on all its other branches. About four-fifths natural size.



The trees, as illustrated in figure 7, are very finely branched; so much so that they can quickly be identified by the masses of small branches and their rather brushlike appearance. The leaves are usually small in size, ovate in shape, with sharply pointed tips, abundant in number, and of a rather light green color. The flowers are perfect and similar to those of the Eureka strain except that the pollen is usually small in quantity and of low vitality.

The typical fruits of the Pear-Shape strain, as shown in Plate IV, are conspicuously and markedly different from the fruits of the other strains. The lemons are oval or pear shaped, with frequently elongated or bottle-necked stem ends, and of small to medium size. The rind is thin and of a very smooth, fine texture. The rag is tender, and the juice is abundant and of low acidity. The fruits average about two or three seeds.

#### DENSE-PRODUCTIVE STRAIN.

The trees of the Dense-Productive strain differ from those of the Eureka strain mainly in their habit of growth and density of foliage. These trees have a dense appearance, owing to the larger number of branches and leaves, and the fruits are largely covered by the protecting foliage. The leaves are of medium size, oval shape, obtuse, abundant in quantity, and from deep to dark green in color. The flowers closely resemble those of the Eureka strain.

The fruits are oblong, medium in size, of smooth texture, and with little or no tendency to ridging. The rind is medium thick, the rag is tender, the juice is abundant and of high acidity, and the fruits average between six and seven seeds.

Owing to the habit of growth of the trees and the density of foliage, the fruits are less likely to climatic injury, or sunburn, than those of the Eureka strain. This condition makes up in part for the somewhat lower production of the trees of this strain as compared with those of the Eureka strain in the performance-record plats.

#### VARIEGATED STRAIN.

In the tree-census studies of Eureka lemons in the orchard in which the performance-record studies were carried on, branches bearing one or more variegated fruits and entire trees producing crops of variegated lemons were discovered. On account of the striking color contrasts of both the fruits and the foliage, representative fruits, branches, or trees of the Variegated strain were easily located.

The habit of growth of the trees of the Variegated strain is open, the production of fruits is good, and the trees bear fruits during all seasons of the year. The bark of the young branches is variegated with fine stripes of shades of green and straw color (Nos. 31 L, 29''', 25''b, and 21'd of Ridgway's Color Standards, edition of 1912). The leaves are oval in shape, obtuse, of medium size, fairly abundant

in number, and variegated in color, as shown in Plate V. The white and green sections of the leaves occur in areas of variable size and shape, in some cases the leaves being almost wholly green, while in others they are nearly or entirely white. The flowers are perfect and apparently like those of the Eureka strain.

The fruits are oblong in shape, of medium size, and rough or ridged in texture. The rinds are thin. The rag is tender, and the juice is abundant and somewhat lacking in acidity. The seeds are similar in number to those of fruits of the Eureka strain.

The fruits have a striped appearance, usually with alternate green and white areas. Accompanying this appearance there is usually a ridged condition which accentuates the striped appearance. The ridges are usually green and the intermediate spaces white. Not only are the leaves and fruits striped or variegated, but the bark of the branches on the trees of this strain also has a similar appearance.

The rough texture of the fruits, their variegated appearance, and the thin rinds, which are liable to split, makes them of inferior commercial value. Many citrus growers in California have taken bud wood from the variegated trees in the performance-record plats in order to grow one or more trees for ornamental purposes.

The chief value of this striking variation lies in its occurrence as single-fruit, branch, and entire-tree variations of the Eureka variety, thus demonstrating its origin from bud variations.

#### SPORTING STRAIN.

In one instance in the performance-record plats, and occasionally throughout the 250-acre grove of Eureka lemons in which these plats are located, trees have been found in vigorous vegetative condition with many branch variations, as shown by both the vegetative and fruit characteristics. In a Sporting tree in one of the performance-record plats, different branches, all grown from a single bud, produce typical fruits of all of the strains under observation and several minor variations of the Eureka variety. Plate VI shows specimens representing several strains and variations borne on one tree grown from a single bud. A similar condition of variability has been observed frequently, so it seems apparent that there exists a strain of the Eureka lemon which breaks up into many variations having very diverse characteristics. Other trees are often found in which only one or two branches are producing fruit of some strain or variation different from the rest of the tree, as illustrated in Plate VII.

The trees of the Sporting strain vary in productiveness and season of production corresponding to the proportions of the various strains produced by them. If the productive strains are dominant, the trees are productive, while if the unproductive strains are most evident the trees are unproductive. As a rule, the trees are comparatively large and show a very vigorous vegetative condition, as illustrated

in figure 8. Usually they develop a spreading habit of growth. The leaf, flower, and fruit characteristics are similar to those of the strains represented in the trees.

It seems probable that these large fine-appearing trees of the Sporting strain are responsible for some of the variability of varieties existing in the established lemon orchards of California. Their handsome appearance naturally attracts the eye of the bud cutters and their vigorous vegetative growth makes it possible to secure a large number of buds from each tree.



FIG. 8.—A typical lemon tree of the Sporting strain of the Eureka variety, seven years planted. This tree is mostly made up of branches showing the characteristics of the Shade-Tree strain, but other strains including the Variegated, Pear Shape, Eureka, and Small Open are represented.

This strain is very undesirable, not only from the standpoint of the mixture of fruits, necessitating additional care in assorting them during packing, but also from the danger of the trees being used as sources of bud wood by inexperienced propagators.

#### LESSONS TAUGHT BY THESE INVESTIGATIONS.

The performance-record studies of individual trees of the Eureka lemon have been particularly interesting, for the reason that the frequent pickings have made possible almost continuous systematic observations throughout the entire year.

The performance-record studies reported in this bulletin have been carried on during a period when the propagation of lemon trees has been particularly active. The lemon industry has expanded rapidly during this time, and the information gained in the course of these investigations has been utilized generally in the propagation of the trees for the large new plantings. A very large number of buds from the superior trees of the Eureka strain in the performance-record plats have been furnished to propagators. These buds from the individual parent trees have been kept separate, so that each progeny can be traced at any time from the orchard planting to the parent trees. Not only have a great number of buds been taken from the best performance-record trees for propagation commercially, but buds from some of the poorest trees have also been propagated at the same time, in order to compare under orchard conditions the behavior of the progenies of the most desirable with those from the undesirable parent trees. The active interest shown by lemon growers in these studies has given the work an additional interest.

The early fruiting of the young trees propagated from the select trees in the performance-record plats permits comparatively quick opportunities for measuring the results of bud selection. The uniformly heavy and superior production of the progenies from the desirable parent trees and the light production of inferior fruits of the progenies from the undesirable parent trees have demonstrated conclusively the importance of bud selection in lemon propagation. The information gained from these investigational individual-tree performance-record data, the demonstrations of the important results of bud selection, and the related observations made during the course of these studies have been the basis upon which have been developed the present improved methods of practice in California in keeping individual-tree records, in the selection of undesirable trees in established orchards for top-working or removal, and in the choice of superior trees as sources of bud wood for propagation.

It is desirable to emphasize the fact that the conclusions presented here have not all been derived from a study of the performance-record data alone. Some phases of tree and fruit characteristics can not be recorded in figures or reproduced by illustrations. These indefinable characteristics are of importance and usually are perceived only by those who have a natural aptitude for this kind of work. The intimate tree knowledge essential for this work is gained only by almost daily and continuous contact with the trees and fruits. The instinct enabling the observer to distinguish one strain of tree or fruit from another and to select the best from among many individuals is almost, if not equally, as important as the actual tree records themselves.



Within some of the strains are marked variations of importance commercially, but not so striking as the variations which distinguish the strains themselves. These individual-tree differences in the strains should be taken into account by the performance-record keeper and this knowledge utilized in the selection of trees for top-working or for use as sources of bud wood.

Fortunately there is a marked correlation between the quantity and quality of the fruits produced by the individual trees of the different lemon strains. The trees bearing the most lemons usually produce the best commercial fruits. In other words, the trees having the heaviest crops frequently develop the largest proportion of lemons of the first grade, as shown by their color, shape, size, texture, thickness of peel, juiciness, acidity, and the flavor of the juice. Usually the most productive trees show the fewest marked variations in fruits from the type of the strain to which they belong. This condition is fortunate in that it enables the grower to form a reliable conception of the value of the fruits of the individual trees from their production records. A similar correlation was found in the studies of the individual-tree production of the various strains of the Lisbon lemon, the Washington Navel orange, the Valencia orange, and the Marsh grapefruit.

#### PRESENTATION OF DATA.

The diagrams and tables presented herewith in summarizing the studies on the Eureka lemon variety have been prepared from individual-tree performance records of 117 trees in a single plat in a 750-acre citrus orchard near Corona, Calif. These trees are in a section of the orchard which was planted in the spring of 1904, nothing except a few crops of winter barley having been grown there previously. Records were begun on 111 of the trees in July, 1911, and 6 more near-by trees were added to the record plat in December, 1912. The original plat selected for this study included 116 trees, but 5 of them were badly injured, so that their records were not comparable with those from the other trees in the plat. Among the 117 trees included in this study there are typical examples of 6 of the 8 most important strains of the Eureka variety, as follows: 76 Eureka, 17 Shade Tree, 10 Small Open, 10 Dense Unproductive, 2 Pear Shape, and 2 Dense Productive.

Individual-tree performance records have been secured in the same orchard on 135 additional Eureka trees. However, as these records have not been made for as long a period as the 117 trees in the original plat, the presentation and consideration of data in this bulletin will be confined to the records of the 117 trees.

The average annual crop of each of these trees for the 6-year period from July, 1911, to June, 1917, inclusive, is shown in Table VI. The percentage of the most desirable fruit of the Green grade, pro-

duced by each tree is also expressed, being figured on the basis of the weight of the crop. The proportion of variable fruits, by number, is shown, as well as the average number of seeds per fruit. In the performance data the number of split fruits have been recorded, as have those showing brown-rot and sunburn, but such fruits are not included in the class of variable fruits. In this table the trees are ranked arbitrarily according to their average annual crops by weight, without regard to the grade or quality of their fruit or its uniformity. This basis of classification was adopted as the simplest and most satisfactory one for this purpose, but its character is such that the rank of the trees as listed does not necessarily give a true index of their actual relative value. It would be impracticable to attempt to rank all the trees of any large plat on such a basis, though it is usually

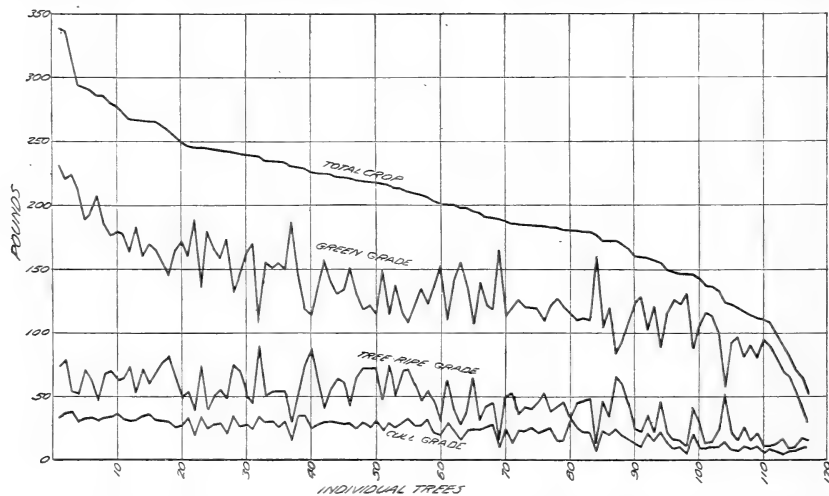


FIG. 9.—Diagram showing the average annual total crops and the production by the three commercial grades from the individual trees in the investigational performance-record plat of Eureka lemons during the 6-year period from July, 1911, to June, 1917, inclusive.

quite possible to select the few of the most desirable individuals and those most undesirable. It is interesting to note that of the 62 highest producing trees listed in this table all but three are of the Eureka strain.

In most cases where summaries are shown, the average or percentages are figured from totals for the period indicated, and not from averages or percentages previously computed.

A graphic representation of the variations in weight of the average annual crops of all the trees in the Eureka lemon plat is presented in figure 9. The trees are arranged from left to right in the order of their rank, on the basis of their total crops as given in Table VI, and the production of fruits of the Green, Tree-Ripe, and Cull grades by each tree is shown.

Table VII represents the main portion of the investigational plat of Eureka lemon trees, showing by symbols the position of each tree and the strain to which it belongs and also indicating its rank in fruit production, by weight, as given in Table VI. The designation of rows and tree numbers serves to show the distribution of the trees of the different strains and ranks throughout the plat.

TABLE VI.—*Summarized statement of the average annual production of 117 individual lemon trees of the Eureka variety for which detailed performance records were obtained for the 6-year period from July, 1911, to June, 1917, inclusive.*

[Detailed performance records of the trees marked with an asterisk (\*) are shown in Table VIII. The trees marked with a dagger (†) were added to the plat in December, 1912. The number of variable fruits is computed from data for the 3-year period from July, 1914, to June, 1917, inclusive. Records of the number of seeds per fruit were for the 5-year period from July, 1911, to June, 1916, inclusive.]

Rank.	Strain.	Tree designation.	Average annual crop production.				Seeds per fruit.
			Weight.	Number.	Green grade.	Variable fruits.	
			<i>Pounds.</i>		<i>Per cent.</i>	<i>Per cent.</i>	
1.....	Eureka.....	*34-73- 7	338.24	1,479.83	68.4	11.4	6.83
2.....	do.....	34-74-21	336.97	1,482.33	65.6	8.0	7.72
3.....	do.....	34-73- 6	315.49	1,383.83	71.1	13.6	5.34
4.....	do.....	34-73-17	293.54	1,311.17	71.9	11.2	7.10
5.....	do.....	34-74-22	291.51	1,319.67	64.5	9.1	6.32
6.....	do.....	†34-73-21	289.64	1,347.60	66.9	10.5	6.88
7.....	do.....	34-73-13	285.77	1,273.67	72.5	10.3	6.60
8.....	do.....	34-74-20	285.74	1,302.17	64.8	8.5	6.34
9.....	do.....	*34-76-23	280.01	1,258.33	63.1	6.0	8.62
10.....	do.....	34-76-21	277.64	1,259.67	64.3	6.0	8.39
11.....	do.....	34-75-12	272.85	1,211.83	64.8	6.7	7.30
12.....	do.....	34-77-19	267.06	1,253.33	60.8	3.6	7.31
13.....	do.....	34-74- 7	266.40	1,176.50	68.8	8.8	6.90
14.....	do.....	34-75-21	266.03	1,203.17	60.0	6.2	6.77
15.....	do.....	34-75-20	265.97	1,157.50	63.8	7.8	8.24
16.....	do.....	34-76-13	265.96	1,211.50	62.1	6.7	7.98
17.....	do.....	*34-77-16	262.42	1,221.33	59.0	4.7	7.86
18.....	do.....	34-77-17	257.95	1,219.33	56.5	4.3	7.31
19.....	do.....	34-76-20	253.65	1,145.50	64.2	4.4	6.96
20.....	do.....	34-73-10	249.14	1,116.67	68.9	10.2	6.10
21.....	do.....	34-74-16	246.41	1,143.83	64.4	7.7	6.75
22.....	Small Open.....	*34-73- 8	244.88	1,037.00	77.0	20.5	4.16
23.....	Eureka.....	34-77-18	244.57	1,168.83	55.1	3.6	8.14
24.....	do.....	34-73- 9	243.50	1,050.33	73.6	11.7	5.85
25.....	do.....	34-73-12	243.14	1,098.17	68.0	12.1	5.34
26.....	do.....	*34-74-10	241.89	1,067.67	65.2	8.9	7.63
27.....	Dense Productive.....	*34-73-19	241.39	1,064.00	71.4	13.3	5.97
28.....	Eureka.....	34-77-22	240.90	1,177.50	54.6	3.1	8.18
29.....	do.....	34-75-11	239.72	1,087.67	60.0	8.3	7.93
30.....	do.....	34-74-14	239.24	1,051.17	67.6	8.7	4.60
31.....	do.....	34-73-14	238.39	1,049.83	71.2	11.5	5.71
32.....	do.....	34-77- 3	238.35	1,147.67	48.0	3.8	7.85
33.....	do.....	34-74-18	234.54	1,055.17	65.7	7.5	3.97
34.....	do.....	34-75-18	234.15	1,063.50	64.3	9.5	6.64
35.....	do.....	*34-75-16	233.80	1,055.00	66.1	9.5	4.37
36.....	do.....	34-76-22	233.73	1,078.67	64.0	5.9	8.80
37.....	do.....	34-73-11	230.17	940.67	81.2	15.5	4.86
38.....	do.....	34-74- 6	228.96	1,052.17	63.0	10.3	6.22
39.....	do.....	34-77-21	228.02	1,107.00	52.0	4.3	7.83
40.....	do.....	34-77-12	225.26	1,043.50	50.3	4.4	8.75
41.....	do.....	34-75-22	224.95	1,015.83	60.1	7.5	5.98
42.....	do.....	34-73-18	224.80	1,065.83	69.8	13.7	6.12
43.....	do.....	*34-76- 8	223.89	1,036.33	62.0	6.7	7.67
44.....	do.....	34-76-15	221.80	1,034.50	58.6	7.1	9.09
45.....	do.....	34-76-18	221.51	1,040.83	60.2	4.5	7.71
46.....	do.....	34-74-19	220.44	977.67	68.2	9.7	4.39
47.....	do.....	34-75- 2	218.47	997.00	59.3	5.8	7.76
48.....	do.....	34-76-17	218.23	1,018.67	53.9	5.4	7.22
49.....	do.....	34-77-15	217.55	1,025.17	55.8	4.8	7.43
50.....	do.....	34-77- 8	217.32	1,058.17	52.4	4.7	8.62
51.....	Small Open.....	34-73- 1	216.50	954.33	68.1	9.3	6.98
52.....	Eureka.....	*34-77-11	215.36	1,030.83	52.6	4.4	9.82
53.....	do.....	34-75-19	213.10	963.00	64.7	8.7	7.25
54.....	do.....	34-77-20	213.02	1,024.83	54.3	4.4	9.07
55.....	do.....	34-76-19	210.25	1,022.50	51.1	5.5	7.98
56.....	do.....	34-76-16	208.89	977.50	58.9	4.9	7.56

TABLE VI.—*Summarized statement of the average annual production of 117 individual lemon trees of the Eureka variety for which detailed performance records were obtained for the 6-year period from July, 1911, to June, 1917, inclusive—Continued.*

Rank.	Strain.	Tree designation.	Average annual crop production.				Seeds. per fruit.
			Weight.	Number.	Green grade.	Variable fruits.	
			<i>Pounds.</i>		<i>Per cent.</i>	<i>Per cent.</i>	
57.	Eureka.	34-74-17	207.28	945.67	64.3	7.2	4.88
58.	do	34-75-5	205.56	970.00	59.0	9.3	7.86
59.	do	34-76-12	202.90	883.83	66.5	7.5	7.91
60.	do	*34-74-8	201.24	834.00	75.7	9.8	6.23
61.	do	34-76-5	200.14	980.50	54.5	5.7	7.23
62.	do	34-76-10	199.28	873.50	69.7	8.2	6.67
63.	Shade Tree.	*34-74-15	197.53	804.17	78.5	13.8	5.10
64.	Eureka.	34-76-11	197.42	870.33	69.4	6.3	7.75
65.	do	34-77-7	194.76	926.83	54.4	5.6	9.02
66.	Dense Productive.	*34-73-16	193.72	897.67	71.6	11.2	7.05
67.	Eureka.	34-75-36	190.05	866.33	64.1	8.2	7.18
68.	do	34-75-3	189.68	891.33	62.0	11.3	6.35
69.	Shade Tree.	34-74-56	188.16	751.33	87.2	12.9	1.11
70.	Eureka.	34-75-7	187.15	845.17	60.1	7.0	6.64
71.	Pear Shape.	*34-74-11	184.89	837.17	63.9	50.4	1.77
72.	Eureka.	*34-73-5	184.64	842.33	68.0	15.8	6.19
73.	do	34-73-4	183.71	826.17	63.3	15.1	6.67
74.	do	34-75-9	183.44	837.67	64.9	6.1	7.91
75.	do	34-75-4	183.42	828.17	64.0	8.0	7.82
76.	do	34-77-9	183.42	860.00	58.9	2.9	7.83
77.	do	34-75-10	182.20	820.67	63.9	7.9	7.99
78.	Small Open	34-77-13	182.18	803.50	69.4	6.9	6.49
79.	do	34-74-2	180.49	804.33	63.9	8.9	2.41
80.	Eureka.	34-74-9	180.37	842.17	64.2	10.6	5.95
81.	Small Open	*34-75-8	179.22	831.00	61.0	6.4	7.77
82.	Eureka.	34-75-17	178.54	823.83	62.3	6.4	4.70
83.	do	34-76-9	178.49	820.33	61.3	6.2	7.55
84.	Shade Tree.	34-74-4	176.43	701.83	89.7	13.2	0.67
85.	Eureka.	34-76-7	171.88	804.83	59.7	7.5	7.80
86.	Small Open	34-73-2	171.23	755.17	69.4	7.9	7.92
87.	Eureka.	34-77-5	171.22	847.00	48.5	4.9	8.27
88.	do	*34-77-6	169.07	803.50	54.7	6.9	8.32
89.	Small Open	34-76-14	165.86	847.00	64.6	8.9	6.87
90.	Shade Tree.	*34-67-12	160.28	671.20	76.8	15.6	1.92
91.	do	34-73-15	158.93	652.00	60.2	20.6	1.35
92.	Small Open	34-74-3	158.06	702.00	64.4	9.6	4.72
93.	Shade Tree.	*34-75-13	156.72	659.00	77.4	15.4	5.28
94.	Small Open	34-76-6	154.61	760.67	56.4	7.7	0.92
95.	Dense Unproductive.	*34-74-12	148.29	621.17	77.4	16.2	4.43
96.	Shade Tree.	34-74-54	147.55	617.00	84.2	16.2	0.97
97.	do	34-74-47	146.53	604.00	83.2	22.2	1.59
98.	do	34-74-5	145.72	568.50	89.6	17.0	0.88
99.	Small Open	*34-75-6	145.61	693.83	58.4	8.5	6.38
100.	Dense Unproductive.	34-77-14	142.29	592.83	73.5	12.7	2.05
101.	Shade Tree.	34-74-51	136.60	599.17	84.9	17.1	1.16
102.	do	*34-74-13	136.14	553.53	82.6	18.0	0.98
103.	do	34-75-14	132.74	554.00	75.2	14.2	1.48
104.	Pear Shape.	*34-77-10	122.55	605.33	46.6	49.7	2.95
105.	Shade Tree.	34-75-15	121.08	491.17	76.2	16.6	1.55
106.	do	34-75-32	117.98	490.83	82.0	10.4	1.43
107.	do	34-75-42	115.15	479.00	68.7	11.3	1.74
108.	do	*34-73-22	112.89	487.60	79.5	17.6	1.26
109.	do	*34-76-56	111.14	470.50	71.9	17.5	1.83
110.	Dense Unproductive.	34-77-4	110.29	459.33	85.0	9.0	1.72
111.	do	34-73-3	107.77	429.83	82.2	26.2	2.00
112.	do	*34-76-3	97.74	404.17	80.4	18.8	2.01
113.	do	34-77-23	89.01	356.00	77.1	14.6	2.09
114.	do	34-76-4	80.90	342.53	81.4	21.3	1.57
115.	do	34-73-40	69.80	308.00	76.2	19.0	1.34
116.	do	*34-75-37	63.63	290.60	61.0	13.4	2.67
117.	do	*34-74-40	51.23	245.20	53.7	13.4	2.92

To indicate more fully and definitely the actual variations of the different trees and their relative values to the investigator and the grower, it is necessary to consider the records of actual production of the individual trees. The number of trees included in this study and the mass of data obtained from them make it impracticable to present



TABLE VIII.—Detailed statement of the annual performance of 24 representative lemon trees of the Eureka variety for the 6-year period from July, 1911, to June, 1917, inclusive.

[The weights of annual production are expressed in pounds and ounces, but the fractional averages are stated decimally in pounds.]

Rank in Table VI, strain, grade, and season.	Total.		July.		August.		September.		October.		November.		December.		January.		February.		March.		April.		May.		June.							
	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.						
<b>I. Eureka strain:</b>																																
Green grade—																																
1911-12.....	301-11	1,100	23-2	81	16-9	65	51-2	192	33-5	128	24-5	96	27-3	99	15-11	61	22-11	81	47-5	102	12-8	45	21-2	71	0-12	25						
1912-13.....	129-1	517	4-13	17	5-8	19	3-12	13	39-6	148	22-15	93	22-5	91	29-3	130	1-3	6	3-14	12	2-7	8	10-6	31	10-15	63						
1913-14.....	45-5	153								4-11	16	8-13	29	4-3	14				3-14	12	2-7	8	10-6	31	10-15	63						
1914-15.....	411-12	1,482	11-6	45	5-9	21	17-12	65	14-9	56	4-11	16	32-14	124	10-0	33	7-2	26	5-14	183	5-4	196	49-1	468	17-10	64						
1915-16.....	290-14	1,090	4-3	16	12-7	47	25-10	98	11-6	45	13-5	68	21-8	80	32-0	125	48-2	177	49-2	183	48-5	176	16-3	60	4-0	15						
1916-17.....	208-1	820	6-8	25	7-5	30	10-2	39	7-8	30	19-8	77	29-1	125	8-6	38			52-11	196	27-10	105	59-6	155	0-0	0						
Average.....	231-13	860	33-10	60	36-80	9	48	36-40	21	68	81-40	21	23	91	33-16	57	17-37	28	132	25-33	119	43	29-23	106	00	27-23	97	00	7-86	29-40		
<b>Tree-Ripe grade—</b>																																
1911-12.....	84-9	379	0-8	4	0	0	0	0	0-5	2	5-6	28	7-6	44	6-11	34	19-6	88	14-11	56	12-7	50	16-7	66	1-6	7						
1912-13.....	47-5	245	0-4	1	0-12	4	0-8	2	4-9	23	0-3	1	11-0	52	28-13	156	1-4	6	1-6	5	0	0	0	0	0	0						
1913-14.....	2-0	7												0	0	0	0	0	0	0	0	0	0	0	0	0						
1914-15.....	159-13	676	0	0	0	0	0	0	1-5	7	1-14	11	17-2	81	28-0	130	10-9	63	45-2	190	40-13	160	2-10	10	6-6	24						
1915-16.....	85-3	408	3-10	16	2-7	11	4-9	21	3-2	15	8-11	36	19-2	95	0-6	42	0-6	3	1-0	39	7-4	33	26-11	120	1-8	7						
1916-17.....	61-0	278	1-3	6	0-12	4	0	0	1-7	7	9-7	13	7-8	51	1-11	47	0	0	0	39	7-4	30	29-12	134	0-0	0						
Average.....	73-31	332	17-11	5-40	0-79	3-80	1-01	4-60	1-86	9-40	2-93	13-83	10-08	53	83-11	86	61-50	9-39	40	00-10	24	42-71	13-71	54	60	15-23	66	40	1-85	7-60		
<b>Cull grade—</b>																																
1911-12.....	12-4	96																														
1912-13.....	138-0	1,308	1-7	9	1-8	9	1-10	11	2-13	30	1-7	12	2-6	20	30-12	214	96-1	1,003	6-12	56	1-15	6	2-0	17	0-10	5						
1913-14.....	0-3	1																														
1914-15.....	16-10	97	0-2	1	0-2	1	0	0	0-14	5	1-0	9	0-6	2	1-0	7	0	0	3-3	18	2-6	13	4-11	26	2-8	15						
1915-16.....	21-10	122	1-4	9	1-8	9	1-2	2	0-11	5	1-2	7	0-6	3	1-2	6	1-0	4	0	2-15	13	9-15	53	0-15	6							
1916-17.....	14-2	106	0	0	0	0	0-2	2	0-3	0	0-3	2	0-1	1	0-1	1	0	0	0-2	1	2-0	11	4-10	33	6-10	49						
Average.....	33-80	287	33-0	70	4-75	0-78	4-75	0-80	5-00	10-00	0-86	6-20	0-64	5-20	6-59	45	60	265	75	0-75	4-43	8-00	4-25	25	80	2-14	15	00				
<b>Total crop—</b>																																
1911-12.....	398-8	1,575	23-10	85	16-9	65	51-2	192	33-10	130	29-11	118	34-9	143	22-6	95	48-13	225	63-15	230	25-14	101	59-9	154	8-12	37						
1912-13.....	314-6	2,070	6-8	27	7-12	32	5-14	20	46-12	201	29-11	106	35-11	163	88-12	500	98-8	1,015	500	25-14	17	2-7	8	11-0	33	10-15	43					
1913-14.....	47-8	161												29	4-3	14			5-4	17	2-7	8	11-0	33	10-15	43						
1914-15.....	588-3	2,250	11-8	46	5-11	22	17-12	65	16-12	68	4-15	180	50-6	207	39-0	172	93-11	328	127-3	491	98-5	309	56-6	204	25-8	103						







Tree-Ripe grade—	414	1-2	5	0	0	0	0	1-0	6	0-12	4	8-2	43	6-4	33	34-0	183	22-11	104	0-2	1	5-10	20	8-0	35	
1911-12	256	1-9	6	0-10	3	0-8	2	2-9	14	1-2	6	9-10	47	24-4	127	8-13	51	0-10	2	0	0	0	0	0	0	
1912-13	550	0	0	0	0-2	0	1	0	0-3	0	3	7-5	36	2-8	9	10-9	221	13-2	56	12-3	46	19-4	76	25-9	104	
1913-14	628	5-14	27	2-3	11	2-4	14	7-6	34	10-6	42	34-5	102	2-5	19	2-9	18	1-13	10	7-1	29	48-10	213	11-5	49	
1914-15	250	1-0	6	0-3	1	0-6	2	0-15	5	1-0	6	0-15	5	5-9	23	2-9	12	8-8	50	0-4	27	23-4	118	1-5	7	
1916-17	350	50	8	80	0.60	3.00	0.78	3.80	11.80	2.34	10.33	10.05	48.83	6.76	85.17	23.98	113.25	7.25	31.71	5.13	20.60	19.85	85.40	9.18	39.00	
Average.....	56	0-6	2	0-10	5	0	0	0-15	9	2-4	27	1-6	11	4-2	38	112-8	1,160	0	5	0-3	2	0-7	3	0	0	
Cull grade—	122	3	8	0	0	0	0	0	0	0-7	5	0	0	0	10	2-8	16	0-3	0	0	0	0	0	0	0	
1911-12	109	0-2	1	0	0	0-10	4	0-4	2	0-4	2	0	0	1-6	2	2-15	26	1-1	9	2-0	8	4-2	38	4-6	26	
1912-13	176	1-11	12	1-15	13	1-1	8	1-0	7	1-6	7	0-4	2	0-5	2	2-15	26	1-1	9	2-0	12	6-10	38	7-5	40	
1913-14	177	0-4	2	0	0	0	0	0	7	0-6	2	0-1	1	0-4	2	2-15	26	1-1	9	1-4	9	3-2	22	8-13	80	
1916-17	288	00	6.61	4.25	0.64	4.50	0.42	3.00	0.55	4.50	0.90	8.60	0.34	2.80	1.21	10.40	30.73	0.43	3.57	0.89	6.20	2.90	20.60	4.14	29.40	
Average.....	327-2	1,307	23-9	84	10-13	41	22-5	83	31-14	123	16-6	59	38-7	152	16-1	69	52-12	257	67-1	265	9-6	35	25-1	84	13-7	55
Total crop—	1912-13	1,912	8-0	29	4-9	12	29-9	20	3-4	125	29-0	141	35-0	157	37-13	205	123-13	1,223	0	3	0-4	1	4-3	14	4-2	15
1913-14	42	8-0	10	12	10-12	1-1	1-1	8	0-4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1914-15	1,540	8-9	33	3-0	12	4-11	20	2-8	10	5-3	21	54-7	219	4-3	21	80-13	341	35-2	131	47-1	173	86-4	336	54-15	221	
1915-16	1,546	10-7	52	6-7	33	13-10	79	33-8	139	15-1	62	37-11	178	5-3	31	15-15	85	50-13	197	60-9	233	76-9	336	26-12	121	
1916-17	982	6-10	31	4-15	19	6-13	28	7-0	30	12-14	56	14-4	61	18-5	75	36-2	36	36-2	145	35-14	146	69-4	304	10-2	87	
Average.....	262	42	1,221	33	11	44	45	80	5	95	25	00	11	44	40	20	89	85	40	13	26	85	40	21	87	99
Variable fruits—	1914-15	33	0	0	0	0	0	0	1	0	1	0	4	1	0	0	0	5	2	2	6	9	9	2	2	
1915-16	65	7	2	0	0	0	0	0	2	0	1	0	2	2	2	2	2	5	22	11	11	9	36	0	0	
1916-17	98	0	0	0	0	0	0	0	0	0	1	0	5	5	5	5	5	5	19	30	30	36	0	0		
Average.....	63	67	3	33	0.67	0.33	1.00	0.33	1.00	1.00	1.00	3.33	3.33	1.33	1.33	3.33	3.33	3.33	14	33	15	67	18	00	1.33	
Average seeds per fruit—	1911-12	4	14	6	0	0	0	0	0	0	0	0	1	0	3	0	0	2	6	6	9	9	14	6	6	
1912-13	5	57	9	10	10	10	10	10	1	0	0	0	2	4	4	4	4	10	10	10	10	10	10	10	10	
1913-14	5	10	12	12	12	12	12	12	7	0	7	0	7	0	0	0	0	6	5	5	4	4	4	4	4	
1914-15	7	58	12	12	12	12	12	12	4	0	4	0	4	0	3	3	3	6	6	6	6	6	6	6	6	
1915-16	12	61	10	10	10	10	10	10	16	0	16	0	8	5	5	5	5	22	14	18	18	13	15	15		
Average.....	7	86	9	20	9.63	5.67	3.30	3.30	5.62	4.09	3.90	10.90	10.90	10.90	10.90	10.90	10.90	10.90	10.90	13.00	13.00	10.90	10.90	9.39		
22. Small-Open strain:	1911-12	68	10-13	39	18-8	70	25-12	96	30-5	116	16-15	62	16-11	60	9-0	33	13-5	46	13-15	47	4-12	17	8-4	27	6-10	25
Green grade—	1912-13	105	11	17	3-13	14	0-11	24	4-12	173	22-13	95	13-9	56	13-9	62	0-10	3	7-8	2	4-3	15	19-8	60	7-6	70
1913-14	244	4-14	17	3-13	14	0-11	24	4-12	173	22-13	95	13-9	56	13-9	62	0-10	3	7-8	2	4-3	15	19-8	60	7-6	70	

TABLE VIII.—Detailed statement of the annual performance of 24 representative lemon trees of the Eureka variety for the 6-year period from July, 1911, to June, 1917, inclusive—Continued.

Rank in Table VI, strain, grade, and season.	Total.		July.		August.		September.		October.		November.		December.		January.		February.		March.		April.		May.		June.					
	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.				
<b>22. Small-Open strain—Continued.</b>																														
<b>Green grade—Con.</b>																														
1914-10	346-10	1,223 21-5	82	4-11	19-10-14	41	9-7	36 57-8	22 53-0	178 42-15	142 32-10	175 28-0	92	8-10	31															
1915-10	279-11	1,036 7-2	27	14-15	56 23-6	89	12-11	48 24-0	149 37-9	136 36-9	135 38-6	138 16-8	63	8-3	36															
1916-17	104-11	625 4-12	18	4-2	16 5-6	21	9-6	36 16-1	37	73 10-1	73 10-1	80 33-0	128	1-0	4															
Average	188.46	698.00	9.75	36.60	9.21	35.00	13.21	49.80	21.51	81.80	66.15	59.68	66.26	12.90	75.20	45.71	29.24	11.85	20.45	71.29	24.11	85.00	20.99	74.00	6.36	32.00				
<b>Tree-Ripe grade—</b>																														
1911-12	31-1	141 0-3	1	0-0	0 0-0	0	0-0	0 1-1	0 0-0	14 4-9	7 2-0	24 7-7	35 5-10	22 4-9	18 3-15	17	0-11	3												
1912-13	23-3	125 0	0	0-8	2 0	0 2-15	13 0-10	9 17-5	98 0	9 17-5	3 1-13	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	
1913-14	1-12	7 0	0	0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	0 0-0	
1914-15	65-6	272 0	0	0-0	0 0-0	0 0-7	2 1-7	7 8-6	40 5-7	26 12-6	49 14-10	61 16-14	64 3-9	14	2-4	9														
1915-16	62-9	267 0	0	0-14	10 1-4	6 2-12	13 2-14	12 18-2	55 6-7	41 2-10	15 1-0	6 3-7	13 19-0	86	2-4	10														
1916-17	45-3	203 1-6	8	0-6	2 0 0-3	0 0-3	1 0-4	2 5-2	26 1-6	6 0-0	5 5-2	21 10-4	41 20-0	91	0-15	5														
Average	38.17	169.17	0.31	1.80	0.55	2.80	0.25	1.20	1.26	5.80	6.11	24.17	5.94	32.83	5.61	24.75	3.93	10.14	7.07	27.40	9.43	41.60	1.23	5.40						
<b>Cull grade—</b>																														
1911-12	4-0	42 0	0	0-0	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	
1912-13	63-0	701 0-9	4	0-10	6 0-5	4 1-7	19 0-3	3 0-9	5 23-2	147 36-8	513 0-10	33 1-5	9 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1913-14	10-1	62 0	0	0-0	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	
1914-15	10-13	62 0	0	0-0	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	0 0-5	
1915-16	17-10	128 0-8	1	0-13	12 0-9	3 0-10	4 2-11	16 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	
1916-17	17-10	128 0-8	1	0-13	12 0-9	3 0-10	4 2-11	16 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	5 0-13	
Average	18.25	169.83	0.31	2.25	0.61	4.50	0.30	2.25	0.59	6.50	0.97	6.40	0.55	4.20	5.00	32.20	10.00	137.25	0.65	4.29	0.80	5.00	1.20	8.20	2.96	19.60				
<b>Total crop—</b>																														
1911-12	210-8	821 11-0	40	18-8	70 25-12	96	30-5	116 18-0	69 19-11	74 13-9	57 24-0	114 20-14	78	9-5	35	12-3	44	7-5	28											
1912-13	162-3	1,248 5-7	21	4-15	22 1-0	6 50-2	205 23-10	101 15-15	70 54-0	307 37-2	516 0-0	33 4-7	34 4-7	16 19-7	63	7-9	71													
1913-14	42-13	261 21-5	82	4-11	19 11-3	43 10-1	39 60-13	23 160-4	53 65-14	230 59-10	230 59-10	212 72-4	253 33-7	115 11-0	42															
1914-15	65-6	1,379 7-10	31	18-10	78 25-3	98 16-1	63 29-9	120 38-3	137 47-14	195 40-3	151 37-12	142 42-5	135 38-7	163 11-0	48															
1915-16	62-9	1,379 7-10	31	18-10	78 25-3	98 16-1	63 29-9	120 38-3	137 47-14	195 40-3	151 37-12	142 42-5	135 38-7	163 11-0	48															
1916-17	227-8	956 6-5	27	4-8	18 5-6	21 9-11	39 16-7	63 24-4	108 11-14	108 11-14	47 0-0	47 0-0	172 31-10	126 54-9	96															
Average	244.88	1,037.00	10.34	40.20	10.25	41.40	13.70	52.80	23.25	92.80	25.13	99.00	27.25	106.33	25.69	118.33	41.80	252.75	95.02	91.71	31.98	117.40	31.61	123.80	10.55	57.00				

Variable fruits—	181	9	4	3	5	31	18	3	16	17	34	33	8
1914-15	400	15	6	7	13	28	37	73	81	60	40	45	4
1916-17	217	1	0	0	9	13	19	8	8	57	48	62	0
Average.....	266.00	8.33	3.33	3.33	9.00	24.00	24.67	28.00	32.33	44.67	37.67	46.67	4.00
Average seeds per fruit—	2.71	4	0	0	0	0	0	1	3	7	4	9	2
1911-12	2.05	2	7	0	3	5	3	4	2	4	5	12	13
1912-13	6.36	4	12	3	0	2	3	1	0	6	16	9	6
1913-14	4.81	4	8	4	3	2	3	0	0	7	13	7	6
1914-15	5.15	7	8	4	3	2	3	0	0	7	13	7	6
1915-16	4.16	4.71	6.88	2.38	2.00	1.25	1.08	0.85	1.22	5.90	10.60	8.90	6.50
Average.....	4.16	4.71	6.88	2.38	2.00	1.25	1.08	0.85	1.22	5.90	10.60	8.90	6.50
26. Eureka strain—	260-6	55	7-6	30	28-5	108	46-11	170	14-14	56	30-15	111	7-4
1911-12	422	4-8	16	4-3	16	1-9	6	34-12	130	7-9	30	14-0	161
1912-13	108-4	45-15	33	1-5	5	2-13	11	1-11	6	0-0	9	0-0	19
1913-14	269-9	62	3-12	15	14-5	54	20-14	80	15-1	60	4-5	17	8-15
1914-15	169-8	91-12	7	1-8	6	2-3	9	4-7	18	10-4	43	18-2	43
1915-16	365	580.50	8.65	25.20	5.73	22.20	11.15	41.80	20.53	76.80	7.81	30.50	17.73
1916-17	157.56	427	3-4	15	0	0-2	1	0-9	3	2-8	12	9-4	2
Average.....	493.13	82	0-10	3	1-2	6	0-8	3	2-4	12	0-6	2	0-8
Tree-Ripe grade—	3-5	13	0	0	0	0	0	0-3	1	0-13	4	5-2	26
1911-12	83-0	331	0	0	0	0	0	0-3	1	0-13	4	5-2	26
1912-13	399-4	399	2-14	15	3-11	18	7-9	30	15-4	83	0-13	4	0-5
1913-14	246	246	0-11	4	0-8	3	0-2	1	1-8	7	0-12	4	1-0
1914-15	53-9	253.00	1.45	7.00	1.33	6.40	0.73	4.00	1.64	8.20	2.00	6.67	6.30
1915-16	55.55	169	2-8	16	0-6	2	0-9	4	1-4	7	0-3	2	0-4
1916-17	22-1	989	2-8	16	0-6	2	0-9	4	1-4	7	0-3	2	0-4
Average.....	111-11	51	0-7	4	0	0	0	0-4	2	0	0	0	0-4
Cull grade—	9-0	51	0-8	1-8	11	1-9	9	0-9	4	0-9	0-9	0-2	2
1911-12	21-14	136	0-8	4	1-8	11	1-9	9	0-9	4	0-9	0-2	2
1912-13	56	56	0-4	2	0	0	0	0	0	0	0	0	0-4
1913-14	234.17	234.17	0.92	6.50	0.47	3.25	0.53	0.20	0.52	3.25	0.18	1.60	0.44
1914-15	28.77	1,542	17-14	70	7-6	30	28-7	104	47-4	173	17-6	68	40-3
1915-16	376-4	1,503	7-10	35	5-11	24	2-10	13	38-4	149	8-2	34	14-12
1916-17	235-11	173	49-13	37	1-5	5	2-13	11	2-2	9	10-7	40	33-11
Average.....	362-3	1,334	19-1	37	1-5	5	2-13	11	2-2	9	10-7	40	33-11
Total crop—	1912-13	1,542	17-14	70	7-6	30	28-7	104	47-4	173	17-6	68	40-3
1913-14	1,503	7-10	35	5-11	24	2-10	13	38-4	149	8-2	34	14-12	
1914-15	1,733	49-13	37	1-5	5	2-13	11	2-2	9	10-7	40	33-11	
1915-16	1,334	19-1	37	1-5	5	2-13	11	2-2	9	10-7	40	33-11	
1916-17	200	27-5	24	6-0	38	5-5	209	70-4	263	75-12	121	55-10	
Average.....	1,334	19-1	37	1-5	5	2-13	11	2-2	9	10-7	40	33-11	









TABLE VIII.—Detailed statement of the annual performance of 24 representative lemon trees of the Eureka variety for the 6-year period from July, 1911, to June, 1917, inclusive—Continued.

Rank in Table VI, strain, grade, and season.	Total.		July.		August.		September.		October.		November.		December.		January.		February.		March.		April.		May.		June.		
	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	
43. Eureka strain—Con. Variable fruits—																											
1914-15.....	40	1	1	0	0	0	0	0	1	1	0	0	0	0	1	1	6	3	3	11	11	13	13	13	13	3	
1915-16.....	84	9	0	0	1	1	1	1	1	1	2	2	2	2	2	11	11	28	6	28	6	19	19	19	19	0	
1916-17.....	74	0	0	2	0	0	0	0	0	0	0	0	0	0	0	6	6	22	22	11	22	23	23	23	0		
Average.....	66.00	3.33	0.67	0.33	0.33	0.67	0.33	0.33	0.67	0.67	1.33	1.33	1.33	3.67	4.00	5.67	14.00	14.00	13.00	18.33	18.33	18.33	18.33	18.33	1.00		
Average seeds per fruit—																											
1911-12.....	4.09	6	6	0	0	0	0	0	0	0	0	0	0	0	3	4	4	4	8	8	5	5	5	5	5		
1912-13.....	5.65	8	8	4	4	4	4	4	2	2	7	7	7	5	3	14	14	14	15	15	11	11	11	11	4		
1913-14.....	7.29	9	9	9	9	9	9	9	0	0	5	5	5	5	11	3	4	4	21	21	13	13	13	13	4		
1914-15.....	8.36	4	4	5	5	5	5	5	0	0	6	6	6	6	11	3	4	4	21	21	13	13	13	13	4		
1915-16.....	10.85	11	11	10	6	6	6	6	10	10	7	7	7	8	5	15	13	13	16	16	14	14	14	14	13		
Average.....	7.67	7.55	7.55	4.63	4.63	3.80	3.80	3.80	3.80	3.80	6.18	6.18	6.18	2.91	5.60	8.22	7.44	15.89	15.89	11.89	11.89	11.89	11.89	11.89	10.20		
52. Eureka strain: Green grade—																											
1911-12.....	178-5	674	17-5	63	17-10	68	15-2	60	26-1	103	13-12	52	17-1	61	6-10	25	6-14	27	30-6	112	6-14	26	10-10	38	10-0		
1912-13.....	50-5	206	0-5	1	0-12	3	1-1	4	10-4	39	5-8	23	15-6	63	17-1	73	0	0	3	1-2	4	3-2	11	70	11		
1913-14.....	5-0	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
1914-15.....	164-3	587	4-3	16	1-0	4	1-7	6	1-14	7	1-6	5	9-13	37	1-2	4	9-3	33	16-9	60	36-14	128	62-4	217	18-8		
1915-16.....	158-7	610	2-8	12	1-8	6	10-9	42	2-15	88	7-5	28	4-3	17	2-9	10	6-4	25	24-14	92	42-1	158	26-5	99	8-6		
1916-17.....	122-11	495	3-12	16	7-0	27	4-0	15	4-13	19	19-7	78	13-9	73	8-13	35	5	16-9	62	19-4	80	25-8	105	6-0			
Average.....	113.16	431.67	5.61	21.60	5.58	21.60	6.44	25.40	12.99	51.20	7.90	31.00	10.00	39.33	6.03	24.50	5.58	21.25	12.62	46.57	21.16	79.00	25.16	92.60	30.60		
Tree-Ripe grade—																											
1911-12.....	126-12	601	7-6	29	0	0	0-13	4	0	0	0-2	1	8-14	40	5-13	27	24-3	133	40-12	189	2-0	9	8-0	30	28-14		
1912-13.....	31-6	163	0-4	1	0-11	4	1-4	8	0-14	6	0-12	4	6-6	29	17-13	92	3-6	19	0	0	0	0	0	0	0		
1913-14.....	0-10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
1914-15.....	64-12	290	0	0	0	0	0	0	0-7	2	0	0	2-5	12	0	0	11-0	46	7-14	33	14-5	51	16-0	62	12-13		
1915-16.....	157-2	745	2-11	14	4-0	22	4-6	23	9-11	48	10-0	65	52-6	262	0-6	2	1-14	15	0	0	0	0	0	0	0		
1916-17.....	61-0	280	0-15	6	0-13	5	0-5	2	2-11	13	0-5	2	2-9	14	4-14	20	0	0	0	0	0	0	0	0	0		
Average.....	73.60	341.83	2.25	10.00	1.10	6.20	1.35	7.40	2.74	13.80	2.86	12.00	12.08	59.50	4.80	23.50	10.11	53.25	9.04	40.28	6.01	23.60	20.20	88.80	10.23		



Cull grade—	20-5	159	2	1-2	7	1-3	13	1-8	15	2-0	18	4-7	13-4	113	2-14	17	1-3	11	0-11	5	2-5	13			
1911-12.....	1,073	0-10	5	0-3	0	0	0	0-11	9	0	0	0	35	96-11	978	0	0	0	0	0	0	0-6	3		
1912-13.....	12	0	0	0	0	0	0	0-11	0	0	0	0	0	0	0	0	0	0	0	0	0	0-4	8		
1913-14.....	1	1	0	0	0	0	0	0-11	0	0	0	0	0	0	0	0	0	0	0	0	0	0-6	3		
1914-15.....	3-8	24	0	0-3	1	0	0	0	0	0	0	0	0	0	0-3	2	0-13	6	0-14	6	1-4	4	8		
1915-16.....	27-7	185	1-6	9-2-6	22	2-3	20	2-2	6	1-3	7	0-2	1	0-9	5	0-10	5	3-13	22	5-11	33	6-9	40		
1916-17.....	11-9	91	0-3	1	0	0	0	0	0	0-12	6	0-5	2	0	1-6	1	1-0	6	1-8	12	6-7	55	55		
Average.....	28.60	257.33	3.75	0.69	6.25	0.83	6.75	0.83	7.00	0.59	6.20	1.01	7.80	27.63	274.00	0.73	4.71	1.36	9.00	1.75	11.20	3.39	23.80		
Total crop—	1911-12.....	1,434	24-11	99	17-10	68	15-15	64	26-1	103	13-14	101	12-6	52	44-5	273	74-0	318	10-1	46	19-5	73	41-3	191	
1912-13.....	1,442	1-3	7	1-10	9	3-7	19	12-5	58	7-12	110	39-5	200	100-1	997	0	0	1-1	4	1-2	4	3-13	15		
1913-14.....	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	
1914-15.....	871	4-3	16	1-3	5	1-7	6	2-5	9	1-6	5	12-2	49	1-5	5	20-3	79	24-10	95	52-0	185	79-2	285	32-9	132
1915-16.....	232-7	33-0	7-14	35	7-14	50	17-2	83	33-12	151	24-2	286	3-1	13	8-11	45	25-8	97	50-15	201	84-8	367	23-2	111	
1916-17.....	195-4	0	23	7-13	32	4-5	17	7-8	32	19-12	80	16-14	78	14-0	57	32-10	131	28-10	122	51-8	234	7-6	60		
Average.....	215.36	1,030.83	8.30	34.60	7.23	32.80	8.45	38.20	16.39	70.60	11.26	48.00	22.74	104.00	11.68	54.90	43.31	348.00	91.57	28.52	111.60	47.11	192.60	21.61	101.80
Variable fruits—	1914-15.....	34	0	0	0	1	0	0	0	0	0	2	2	2	0	5	0	2	10	0	10	0	2	2	
1915-16.....	28	4	2	0	0	0	0	0	0	0	1	3	3	0	0	0	4	4	7	0	3	0	4	4	
1916-17.....	83	0	0	0	0	0	0	2	2	2	3	3	3	0	0	0	26	26	33	0	14	0	0	0	
Average.....	48.33	1.33	0.67	0.33	0.67	0.67	2.00	2.00	2.67	2.67	10.67	10.67	10.67	1.67	1.67	1.67	10.67	10.67	16.67	9.00	9.00	2.00	2.00	2.00	
Average seeds per fruit—	1911-12.....	5.77	4	0	0	1	0	0	0	0	0	6	4	4	11	11	4	4	8	0	15	0	9	9	
1912-13.....	6.87	11	6	5	3	5	0	0	0	0	6	6	6	15	15	15	0	0	10	16	16	0	11	11	
1913-14.....	11.85	4	3	4	4	4	1	1	7	7	3	5	5	8	8	8	19	19	27	19	19	10	10	10	
1914-15.....	11.44	4	13	10	8	8	0	0	7	7	11	11	11	9	9	9	21	21	19	15	15	16	16	16	
1915-16.....	12.74	13	13	10	8	8	0	0	7	7	11	11	11	9	9	9	21	21	19	15	15	16	16	16	
Average.....	9.82	9.33	7.22	5.67	3.89	3.89	6.00	6.00	7.20	7.20	15.71	15.71	15.71	10.78	10.78	10.78	17.40	17.40	16.67	9.00	9.00	2.00	2.00	2.00	
Eureka strain—	1911-12.....	771	14-3	51	22-7	83	30-13	114	44-6	153	24-14	91	6-11	24	15-0	52	18-9	64	5-11	20	6-7	22	3-1	10	
Green grade—	1912-13.....	602	1-12	6	2-10	10	2-13	10	56-0	208	41-15	98	25-5	106	0-4	1	3-6	11	2-7	8	12-2	39	9-11	38	
1913-14.....	130	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1914-15.....	282-12	40	1-9	6	4-6	16	3-15	15	21-14	78	39-15	145	3-4	12	49-14	168	21-14	74	81-7	207	34-12	114	7-6	26	
1915-16.....	161-2	604	3-2	14	5-10	60	22-2	83	11-15	47	1-11	6	5-6	30	17-12	66	20-7	110	26-7	95	13-4	49	5-13	23	
1916-17.....	58-11	228	6-2	25	5-2	19	1-14	8	3-12	14	2-7	14	2-7	10	3-4	7	4	26	5-0	19	20-12	79	0-8	2	
Average.....	152.33	550.00	7.66	28.40	9.48	35.60	12.40	46.20	24.02	87.40	15.47	64.17	8.50	33.33	20.72	71.75	11.50	40.71	24.20	81.80	17.46	60.60	5.29	19.80	
Tree-Ripe grade—	1911-12.....	104	0-11	3	0	0	0-2	1	0-6	2	0-11	3	2-9	16	7-5	33	5-12	22	2-2	8	2-6	9	0-7	2	
1912-13.....	14	72	0-4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1913-14.....	0-14	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	







1915-16.....	12-4	81	0-14	6	0-8	4	0-9	2	0-9	5	1-0	6	0	0	0-7	4	1-6	7	4-2	28	2-4	13					
1916-17.....	15-3	117	0-14	6	0	0	1-11	2	1-11	15	0	0	0	0	0-6	4	0-14	7	4-0	28	7-6	57					
Average.....	23.71	233.83	0.36	4.00	0.19	1.50	0.56	2.34	0.36	3.75	0.23	1.40	1.13	8.20	3.56	24.20	19.88	241.50	0.46	3.43	5.20	2.56	16.80	16.40			
Total crop—																											
1911-12.....	179-12	709-15-1	56	9-6	37	16-14	64	97-15	99	10-4	99	10-4	42	16-4	64	2-14	13	15-4	81	21-15	80	13-9	52	21-11	83	8-11	38
1912-13.....	161-8	1,377	2-11	13	1-12	9	2-8	15	7-8	36	18-2	71	14-7	68	40-9	68	40-9	244	73-15	92	1-0	3	2-2	8	9-7	31	6-7
1913-14.....	22-13	79																									
1914-15.....	360-13	1,360	13-11	55	2-14	12	7-3	28	4-6	17	22-13	90	98-12	157	2-12	10	61-3	222	64-14	249	86-10	313	38-12	141	14-15	57	
1915-16.....	245-8	996	10-0	47	14-9	58	20-11	81	11-14	48	13-15	55	28-11	129	14-13	65	29-15	111	38-4	145	27-7	102	26-3	118	9-2	40	
1916-17.....	191-15	865	3-11	18	0-11	3	2-8	10	11-2	46	21-3	87	34-2	163	11-8	40											
Average.....	193.72	897.67	9.03	37.80	5.85	23.80	9.95	39.60	12.56	49.20	14.43	57.67	22.30	97.00	12.75	66.17	45.08	333.75	22.48	85.86	30.60	114.20	28.25	117.20	9.31	43.20	
Variable fruits—																											
1914-15.....		69																									
1915-16.....		151																									
1916-17.....		140																									
Average.....		120.00																									
Average seeds per fruit—																											
1911-12.....		7.14																									
1912-13.....		4.91																									
1913-14.....		8.40																									
1914-15.....		6.57																									
1915-16.....		8.37																									
1916-17.....		7.05																									
Average.....		7.05																									
71. Pear-Shape strain:																											
Green grade—																											
1911-12.....	178-10	638	6-8	24	9-8	37	23-12	86	48-13	182	17-0	59	49-3	166	5-6	20	8-0	28	7-8	25	0-14	3	0-5	1	1-13	7	
1912-13.....	83-7	335	0-13	3	1-7	5	2-14	11	23-13	87	12-7	49	17-15	71	23-14	108	0-4	1									
1913-14.....	21-1	74																									
1914-15.....	187-7	705	14-0	53	21-13	88	21-11	86	12-3	47	37-1	170	45-5	18	4-10	5	5-4	3-1	10	0-4	1	1-12	6	5-0	19		
1915-16.....	169-1	623	2-2	8	12-11	45	36-5	130	31-7	113	13-15	52	11-7	43	10-13	42	12-1	46	12-10	49	11-2	38	9-14	38	4-10	14	
1916-17.....	69-14	304	2-2	8	3-5	12	2-7	10	13-3	52	17-14	73	26-1	130	0	0											
Average.....	118.25	446.50	5.11	19.20	9.75	37.40	17.41	64.60	25.89	96.20	16.57	62.83	25.86	99.67	7.78	32.17	7.42	26.75	3.83	13.85	4.43	15.40	4.66	16.80	3.09	11.80	
Tree-Ripe grade—																											
1911-12.....	50-7	219	0-10	3	0	0	0	0	0-4	1	1-13	9	11-15	50	6-0	31	15-14	71	10-14	42	0-14	4	1-13	7	0-6	1	
1912-13.....	17-5	87																									
1913-14.....	5-1	19																									
1914-15.....	92-1	471																									
1915-16.....	58-4	277	0-15	4	1-12	9	2-5	10	2-7	10	13-12	56	26-0	33	2-4	13	2-4	9	4-14	21	5-14	22	5-14	19	3-10	15	
1916-17.....	90-7	578	2-0	10	0-6	2	0-8	3	1-12	9	21-0	116	55-11	336	2-2	11	0-9	3	0-6	2	2-5	9	5-11	28	0	0	
Average.....	53.76	275.17	0.71	3.40	0.56	2.80	0.56	2.60	1.86	9.40	6.79	33.50	26.91	149.00	3.88	19.83	4.67	20.75	2.64	10.57	1.86	7.20	5.48	26.80	0.95	3.80	





TABLE VIII.—Detailed statement of the annual performance of 24 representative lemon trees of the *Eureka* variety for the 6-year period from July, 1911, to June, 1917, inclusive—Continued.

Rank in Table VI, strain, grade, and season.	Total.		July.		August.		September.		October.		November.		December.		January.		February.		March.		April.		May.		June.				
	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.			
72. <i>Eureka</i> strain—Con.																													
Average seeds per fruit—Cont'd.																													
1914-15.	5.00	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
1915-16.	9.22	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8			
Average.	6.19	7.44	4.71	7.14	3.82	3.30	2.00	5.75	6.56	5.78	11.22	9.56	8.40																
81. Small-Open strain: Green grade—																													
1911-12.	198-11	729	14-12	56	12-15	9	3-3	12	2-7	93	41-14	154	21-10	79	21-2	78	10-11	40	11-9	40	18-6	64	5-10	20	11-5	38	4-9	16	
1912-13.	85-0	342	2-7	9	3-3	12	2-7	10	15-8	62	33-8	133	17-4	71	10-11	45	0	0	0	0	0	0	0	0	0	0	0	0	
1913-14.	8-5	30	3-3	12	1-2	4	6	8	1-5	5	5-3	21	23-5	94	0-14	3	19-8	71	30-12	112	49-6	178	24-0	8	0-2-6	8	1-12	7	
1914-15.	170-14	620	3-3	12	1-2	4	6	8	1-5	5	5-3	21	23-5	94	0-14	3	19-8	71	30-12	112	49-6	178	24-0	8	0-2-6	8	1-12	7	
1915-16.	118-15	464	2-4	6	6-12	25	12-10	31	17-14	71	0-13	3	1-0	4	3-8	15	5-0	20	19-11	76	21-5	81	22-3	86	5-15	23	0	0	
1916-17.	73-15	296	3-4	13	4-0	16	3-0	12	4-2	16	6-14	28	9-11	41	3-9	15													
Average.	109.29	415.00	5.18	19.80	5.00	21.60	8.94	34.80	16.14	61.60	11.38	44.17	12.06	48.00	5.39	21.50	9.01	32.75	11.07	40.71	17.97	66.20	15.60	58.20	4.43	16.20			
Trees—Type, grade—																													
1911-12.	28-0	123	0-3	1	0	0	0	0	0	0	0-3	1	2-11	14	2-6	12	6-10	30	10-6	42	0-15	4	2-14	11	1-12	8			
1912-13.	33-6	168	0	0	0-2	1	0	0	2-9	12	3-10	17	3-3	15	23-14	123	0	0	0	0	0	0	0	0	0	0	0	0	0
1913-14.	0-4	203	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1914-15.	60-5	282	0	0	0	0	0	0	0	0	0-5	2	0-2	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1915-16.	117-9	561	3-2	15	3-8	18	6-11	33	3-0	14	16-14	69	41-2	203	4-8	32	1-2	6	1-0	6	5-6	22	28-15	133	2-5	10	14	10	
1916-17.	26-13	121	0-6	2	0	0	0	0	0	0	0-6	2	2-9	14	1-8	6													
Average.	44.39	266.17	0.74	3.60	0.73	3.80	1.34	6.60	1.11	5.20	3.56	15.17	9.28	46.33	5.38	28.83	6.03	27.50	4.46	18.85	5.26	21.80	9.56	43.00	1.59	6.60			
Cull grade—																													
1911-12.	6-15	45																											
1912-13.	110-10	987	1-0	5	0-6	6	0-10	4	1-0	7	0-13	11	1-0	9	27-11	179	78-2	768	4-0	26	1-10	9	0-8	3	0-6	4	0-7	3	
1913-14.	0-3	1																											
1914-15.	4-3	23	0-3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1915-16.	26-11	170	1-1	7	1-8	13	0-8	4	2-0	14	0-13	6	0-2	1	0-13	5	0-6	3	0-8	4	5-5	30	1-3	65	2-8	18	14	10	
1916-17.	4-10	33	0-3	1	0	0	0	0	0	0	0	0	0	0	1-11	13	0	0	0	0	0	0	0	0	0	0	0	0	
Average.	25.54	269.83	0.81	3.50	0.47	4.75	0.28	2.00	0.75	5.27	0.33	3.40	0.56	4.60	5.70	36.80	20.91	200.50	0.40	2.43	1.28	7.20	2.69	16.20	1.13	7.40			







1914-15.....	172-2	3 4-8	17 0-12	3 4-8	17 4-7	1620-2	74 39-2	144 7-2	0 5-1	113-15	4717-8	6034-4	112 27-12	91 5-1	18													
1915-16.....	151-12	34 12-2	9 9-7	46 10-0	37 3-14	37 3-14	13 8-7	7 7-2	107 28-6	28 12-12	4930-0	107 28-6	102 20-3	74 9-9	36													
1916-17.....	95-11	14 2-2	13 3-10	8 3-11	14 4-14	19 8-7	13 8-7	37 4-2	61 17-4	16.....	4500-3	61 17-4	64 31-10	118 0	0													
Average.....	121.24	5.26	22.40	5.65	20.80	10.06	36.20	20.25	74.00	17.96	68.00	19.79	78.80	35.57	16.61	57.80	17.84	63.00	4.18	15.20								
Tree-Ripe grade—																												
1911-12.....	14-4	63 1-0	4 0	0 0-10	4 1-7	6 3-3	13 2-8	11 1-2	5 0-8	12 2-4	11 1-2	5 0-8	2 1-10	6 0	0													
1912-13.....	23-2	110 0-12	3 0	0 0-10	3 0-3	1 3-0	14 18-9	0	0	89 0	0	0	1	0	0													
1913-14.....	0-3	1	0 0	0 0-10	0 0-3	1 7-10	37 0-7	24 5-15	25 3-11	2 8-8	24 5-15	25 3-11	12 2-1	0	0													
1914-15.....	26-7	113 0	0 0	0 0-10	0 0-3	1 7-10	37 0-7	24 5-15	25 3-11	2 8-8	24 5-15	25 3-11	12 2-1	0	0													
1915-16.....	36-4	167 0-10	3 0-8	2 0-3	1 0-14	8 4-12	21 4-2	17 0-6	3 0-11	17 0-6	3 0-11	4 1-8	6 18-11	82 3-11	16													
1916-17.....	25-14	111 0-10	3 0-4	1 0-3	1 0-6	2 0-3	1 1-14	10 0	6 9-9	0	6 9-9	25 4-0	16 9-8	39 2-5	13													
Average.....	21.02	94.17	0.60	2.60	0.83	3.40	4.09	19.00	3.96	20.00	9.50	8.43	7.40	6.38	27.00	1.40	6.60											
Cull grade—																												
1911-12.....	5-5	37																										
1912-13.....	59-14	524 0-2	1 0-6	4 0-3	1 0-5	2 0-9	4 2-14	18 29-10	157 25-13	4-4	28 0-4	2 0-11	4 0-2	3 0	0													
1913-14.....	1	32 0-6	3 0	0 0	0 0-10	4 0	0 0-2	1 1-1	6 1-15	0	0	0	0	1 0	0													
1914-15.....	5-2	39 0	0 0	0 0-7	2 0-3	1 0-7	3 0	0 0	0 0-9	4 0-6	4 0-6	2 0-6	3 2-11	15 1-10	9													
1915-16.....	6-11	67 0-6	2 0	0 0	0 0	0 0	0 0	0 0-2	1 0-2	1	0-2	1 0-6	1 0-6	3 8-8	59													
1916-17.....	9-10	116.67	0.22	1.50	0.09	1.00	0.16	0.75	0.41	0.75	0.41	2.75	0.72	4.50	5.98	31.80	7.92	93.75	0.38	2.43	0.24	1.60	0.80	5.20	2.09	14.00		
Average.....	14.46	116.67	0.22	1.50	0.09	1.00	0.16	0.75	0.41	0.75	0.41	2.75	0.72	4.50	5.98	31.80	7.92	93.75	0.38	2.43	0.24	1.60	0.80	5.20	2.09	14.00		
Total crop—																												
1911-12.....	168-13	650 14-10	65 11-3	43 30-11	10 38-15	136 21-4	74 13-13	64 9-0	36 10-0	36 10-0	51 6-5	24 3-13	15 5-12	22 3-7	12													
1912-13.....	229-14	1,215 3-7	14 3-10	14 0-12	3 45-12	176 41-14	170 40-15	174 67-11	327 25-13	337	337	4 0-12	3 5-12	20 2-13	10													
1913-14.....	12-1	42	20 0-12	3 4-8	17 4-7	16 20-15	79 46-12	181 0-14	5 20-8	77 25-6	1-4	4 0-12	124 30-8	103 6-6	24													
1914-15.....	203-11	745 4-12	20 0-12	3 4-8	17 4-7	16 20-15	79 46-12	181 0-14	5 20-8	77 25-6	1-4	4 0-12	124 30-8	103 6-6	24													
1915-16.....	194-11	758 2-14	12 9-15	36 13-1	49 11-1	42 6-7	25 10-3	41 9-11	45 13-11	52 31-1	113 30-4	111 41-9	171 14-14	61														
1916-17.....	131-3	544 4-8	20 3-14	15 2-5	9 4-1	16 5-1	20 10-9	47 4-4	17	22-14	87 21-6	81 41-8	160 10-13	72														
Average.....	156.72	659.00	6.04	26.20	5.88	22.20	26.37	20.85	77.20	19.11	73.60	24.45	101.40	15.50	72.33	17.50	129.25	12.41	46.43	18.82	66.80	25.01	95.20	7.66	35.80			
Variable fruits—																												
1914-15.....	71		1	0	0	2	3	7	0	0	3	8	14	26	7													
1915-16.....	117		5	3	2	2	0	6	9	22	25	25	7	31	2													
1916-17.....	128		0	3	2	2	2	8	6	6	27	27	39	41	0													
Average.....	105.33		2.00	2.67	1.00	2.00	1.67	7.00	5.00	8.33	20.00	20.00	20.00	32.67	3.00													
Average seeds per fruit—																												
1911-12.....	2.52		1	0	1	1	0	0	3	0	5	9	3	1	6													
1912-13.....	1.70		2	6	3	1	0	0	0	0	9	10	8	4														
1913-14.....	7.00		2	10	7	0	3	1	4	4	4	7	10	13														
1914-15.....	5.56		2	10	5	9	6	6	5	8	14	14	16	7														
1915-16.....	8.67		10	5	5	9	6	6	5	8	14	14	16	7														
Average.....	5.28		3.44	5.15	4.15	3.44	2.64	1.56	3.55	6.12	9.44	10.33	5.78	8.88														

TABLE VIII.—Detailed statement of the annual performance of 24 representative lemon trees of the Eureka variety for the 6-year period from July, 1911, to June, 1917, inclusive—Continued.

Rank in Table VI, strain, grade, and season.	Total.		July.		August.		September.		October.		November.		December.		January.		February.		March.		April.		May.		June.			
	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.		
95. Dense- $\bar{U}$ nproductive strain:																												
Green grade—																												
1911-12.....	180-0	639	12-4	44	17-14	69	46-3	163	41-10	147	15-13	58	25-10	85	2-11	10	4-4	14	5-9	20	3-10	13	3-5	12	1-3	4		
1912-13.....	84-11	326	1-2	4	0-14	3	1-2	5	19-5	71	30-9	116	19-3	73	12-8	54	0	0	0	0	0	0	0	0	0	0	0	
1913-14.....	19-7	68																										
1914-15.....	211-2	747	7-8	28	2-14	11	3-13	16	4-5	17	27-7	102	3-0	2	4-6	15	4-6	157	11-15	8	1-8	5	3-10	12	4-10	18		
1915-16.....	133-11	504	2-5	9	15-5	56	7-8	29	6-1	23	12-1	45	10-3	39	17-7	67	16-12	63	13-8	36	13-8	54	16-10	158	8-4	30		
1916-17.....	59-13	223	5-8	23	0	0	0-8	2	2-7	11	2-40	10	3-1	12	1-14	7	0	0	10-8	33	6-14	25	26-7	100	0	0		
Average.....	114.79	417.83	5.74	21.60	7.39	27.80	11.86	43.00	14.75	53.80	17.70	66.20	15.81	56.83	6.85	27.00	16.90	58.50	5.75	20.00	8.20	29.40	19.80	71.00	3.54	13.20		
Tree-Ripe grade—																												
1911-12.....	11-12	56	0	0	0	0	0	0	0	0	0-6	2	2-0	9	2-0	12	4-2	18	1-10	8	1-1	4	0-9	3	0	0		
1912-13.....	6-6	31	0	0	0	0	0	0	0-3	1	0-5	1	1-15	9	3-15	20	0	0	0	0	0	0	0	0	0	0	0	
1913-14.....	0	0																										
1914-15.....	57-12	247	0	0	0	0	0	0	0-10	3	0-10	3	3-12	18	8-11	43	22-15	94	8-10	37	1-8	6	10	25	4-6	18		
1915-16.....	37-8	177	1-3	5	0-9	3	0-14	0	0-3	1	3-5	13	3-14	19	3-6	24	3-1	0	0	0	0	0	0	0	0	0	0	
1916-17.....	12-6	49	0-11	4	0	0	0	0	0	0	0	0	0-3	1	1-2	4	0	0	3-10	11	1-10	7	5-2	22	0	0		
Average.....	20.96	93.33	0.38	1.80	0.11	0.60	0.18	0.80	0.20	1.00	0.93	3.80	1.96	9.33	13.19	17.17	6.81	28.25	1.98	8.00	1.19	4.60	5.98	25.60	1.80	8.20		
Cull grade—																												
1911-12.....	4-3	34																										
1912-13.....	45-10	455	0-4	2	0	0	0-3	1	0-8	3	0-2	3	0-12	4	8-5	48	35-8	394	0	0	0	0	0	0	0	0		
1913-14.....	0-2	1																										
1914-15.....	7-3	46	0	0	0	0	0	0	0-6	3	0-2	1	1-11	6	0	0	0	2-8	17	0-12	5	0-9	5	0-12	6	0-7	3	
1915-16.....	9-4	58	0-6	3	0-5	2	0-5	2	0-3	1	0	0	0-3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	
1916-17.....	8-14	66	0-15	6	0	0	0-2	1	0	0	0	0	0-3	2	0	0	0	0	0	0	0	0	0	0	0	0		
Average.....	12.54	110.00	0.39	2.75	0.07	0.50	0.16	1.00	0.21	1.50	0.14	1.50	0.59	2.80	1.66	9.60	10.31	109.50	0.14	1.00	0.31	2.60	1.09	6.80	2.16	15.40		
Total crop—																												
1911-12.....	195-15	729	12-4	44	17-14	69	46-3	163	41-10	147	16-13	60	27-10	94	4-11	22	11-10	59	7-7	30	4-14	18	4-4	18	1-5	5		
1912-13.....	136-11	812	1-6	6	0-14	3	1-5	6	20-0	75	31-0	120	21-14	86	24-12	122	35-8	394	0	0	0	0	0	0	0	0		
1913-14.....	19-9	69																										
1914-15.....	276-1	1,040	7-8	28	2-14	11	3-13	16	5-5	23	28-3	106	39-7	146	10-15	52	72-1	268	21-5	85	17-9	63	54-0	180	13-1	51		

1915-16.....	180-7	739	2-14	1716-3	61	8-14	35	6-4	2415-11	6014-4	5920-13	9116-15	64	9-12	3616-1	6340-7	17311-5	56									
1916-17.....	81-1	338	7-2	33	0	0-10	3	2-7	11	2-10	15	3-0	11	14-2	44	8-8	3232-0	127-3	54								
Average.....	148.29	621.17	6.42	25.60	7.56	28.80	12.16	44.60	25.13	56.00	18.74	52.17	34.03	196.25	7.87	29.00	9.70	36.60	26.96	103.40	7.90	36.80					
Variable fruits—																											
1914-15.....	128		4	0	0	0	0	0	1	7	1	1	27	6	10	10	57	14									
1915-16.....	148		12	4	5	148	0	0	6	11	16	22	23	18	3	23	23	5									
1916-17.....	67		1	0	0	0	0	0	1	0	2	1	1	20	18	24	24	0									
Average.....	114.33		5.67	1.33	1.67	1.67	1.67	1.67	2.67	6.00	6.33	8.00	16.67	14.67	10.33	34.67	34.67	6.33									
Average seeds per fruit—																											
1911-12.....	2.05		1	0	1	1	1	1	0	0	1	0	8	5	1	3	3	2									
1912-13.....	1.44		0	1	1	3	2	2	0	2	0	0	7	7	1	1	1	2									
1913-14.....	4.88		2	0	3	1	1	3	1	1	10	7	1	6	5	0	0	1									
1914-15.....	7.49		8	10	7	5	4	2	5	4	2	0	4	27	14	9	11	9									
1915-16.....	4.43		3.71	5.33	3.57	2.33	1.82	1.82	2.33	1.82	1.83	1.20	4.50	7.29	9.44	6.89	8.00										
Average.....	4.43		3.71	5.33	3.57	2.33	1.82	1.82	2.33	1.82	1.83	1.20	4.50	7.29	9.44	6.89	8.00										
99. Small-Open strain:																											
Green grade—																											
1911-12.....	105-14	385	8-14	34	8-1	31	9-4	35	14-8	53	13-8	49	14-7	52	3-15	15	5-7	20	11-0	40	2-4	8	8-14	32	6-12	26	
1912-13.....	44-6	183	0-8	2	1-6	6	1-2	5	9-0	36	9-9	40	13-7	54	8-15	38	0-7	2	0	2	0	0	1-2	4	0-15	4	
1913-14.....	3-2	12																									
1914-15.....	155-0	574	1-7	6	1-0	4	1-10	6	1-4	5	6-0	23	18-6	75	2-7	8	21-2	7	4	19-15	72	28-0	104	34-4	125	19-9	72
1915-16.....	109-2	413	1-4	5	2-9	10	6-13	26	6-0	3	1-3	5	2-5	10	9-5	37	20-4	75	25-5	93	21-2	80	12-2	45	12-2	45	
1916-17.....	90-14	376	5-12	23	4-0	16	3-0	10	6-10	21	25-9	11	1-4	11	1-4	5	12-6	48	20-0	80	6-0	28	0-4	1	0	1	
Average.....	84.90	325.50	3.56	14.00	3.40	13.40	4.36	16.40	7.48	29.00	7.00	27.20	12.38	50.67	3.19	12.83	9.07	33.25	9.16	33.86	15.11	57.00	14.28	53.80	7.93	29.60	
Tree-Ripe grade—																											
1911-12.....	30-3	137	1-2	5	0	0	0	0	0	0	15	1-6	7	6-6	33	7-5	31	1-10	7	3-9	14	4-11	21				
1912-13.....	30-6	157	0-4	1	1-6	7	0-8	3	0-7	2	1-11	9	2-5	11	23-8	122	0-5	2	0	0	0	0	0	0	0	0	
1913-14.....	0	0																									
1914-15.....	81-7	355	0	0	0	0	0	0	0	1	9-10	50	0	0	20	1-11	89	21-14	92	12-15	56	7-11	31	8-4	35		
1915-16.....	53-12	258	0-7	2	2-6	12	0-7	2	1-10	8	6-14	27	7-5	36	2-3	17	3-7	20	0-15	8	2-10	11	2-10	98	3-14	17	
1916-17.....	47-10	219	0-10	4	0-10	4	0	0	0-10	5	3-7	20	2-7	20	2-7	10	6-13	27	7-9	33	24-0	110	0-10	3			
Average.....	40.56	187.67	0.49	2.40	0.88	4.60	0.19	1.00	0.58	2.80	2.11	9.20	4.31	22.00	4.92	26.00	7.70	36.00	5.28	22.57	4.95	21.40	11.38	50.60	3.49	15.20	
Cull grade—																											
1911-12.....	6-10	53																									
1912-13.....	89-7	868	0-10	4	0-4	3	0-2	1	0-1	2	0-10	9	0-11	7	24-7	139	62-7	4-5	35	1-6	11	0-2	1	0-8	4	0-5	2
1913-14.....	0	0																									
1914-15.....	7-5	46																									
1915-16.....	10-6	64	0-12	5	0-9	4	0-12	5	0	0	4	2	0-4	1	0	3	2	0-4	2	0-4	2	0-4	2	2-9	15	2-13	16
1916-17.....	7-3	55	0-8	3	0	0	0-8	3	0-3	2	0-5	2	0-8	6	0	0	0	0-11	6	1-8	11	1-4	10	1-12	12		
Average.....	20.16	180.67	0.49	3.00	0.20	1.75	0.34	2.25	0.03	1.00	0.48	3.50	0.32	3.00	4.93	32.10	16.84	180.25	0.48	3.71	1.00	6.40	1.44	9.20	1.23	7.40	

TABLE VIII. Detailed statement of the annual performance of 24 representative lemon trees of the Eureka variety for the 6-year period from July, 1911, to June, 1917, inclusive (Continued).

Rank in Table VI, strain, grade, and season.	Total.		July.		August.		September.		October.		November.		December.		January.		February.		March.		April.		May.		June.			
	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.		
<b>99. Small-Open strain Continued.</b>																												
Total crop.....	143-11		585-10-0	39	8-1	31	9-4	35	14-8	53	14-7	53	17-10	67	5-5	22	16-2	88	19-11	82	4-0	16	12-15	50	11-12	49		
1911-12.....	164-3		1,206	1-6	7	3-0	16	1-12	9	9-8	40	11-14	58	10-10	72	56-14	319	63-3	685	0-0	2	0	1-2	4	0-15	4		
1912-13.....	163-11		1,206	1-6	7	3-0	16	1-12	9	9-8	40	11-14	58	10-10	72	56-14	319	63-3	685	0-0	2	0	1-2	4	0-15	4		
1913-14.....	163-11		1,206	1-6	7	3-0	16	1-12	9	9-8	40	11-14	58	10-10	72	56-14	319	63-3	685	0-0	2	0	1-2	4	0-15	4		
1914-15.....	243-12		975	1-7	12	5-8	26	1-0	4	1-10	6	7-7	26	28-2	126	2-7	8	12-3	106	42-14	171	42-5	169	14-13	173	29-1	114	
1915-16.....	173-4		735	2-7	16	1-8	26	8-0	33	7-10	32	7-11	31	8-10	42	4-1	29	13-0	59	21-7	85	29-15	115	45-5	193	18-13	78	
1916-17.....	145-11		650	6-14	30	4-10	20	3-8	13	7-7	32	6-4	28	30-8	143	3-11	15	15	19-14	81	29-1	124	31-4	148	2-10	16		
Average.....	145.61		693.83	4.42	18.80	4.44	19.40	4.83	19.20	8.10	32.60	9.38	39.20	46.96	75.17	12.21	65.67	33.62	949.60	14.92	60.14	21.06	84.80	27.08	113.60	12.64	52.29	
<b>Variable fruits--</b>																												
1914-15.....	46		46	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	6	5	5	5	5	16	12	12	4	
1915-16.....	75		75	2	0	3	0	3	0	2	2	2	2	18	18	18	1	1	14	23	23	23	23	11	13	13	4	
1916-17.....	80		80	0	0	0	0	0	0	5	5	5	2	2	2	2	1	1	1	10	10	10	10	32	12	12	0	
Average.....	67.00		67.00	1.00	0	1.00	0	1.00	0	2.33	2.33	1.33	3.33	6.33	6.33	0.07	0.07	6.07	12.07	12.07	12.07	12.07	16.00	13.07	13.07	5.33		
<b>Average seeds per fruit--</b>																												
1911-12.....	4.29		4.29	5	4	4	4	4	0	0	0	10	3	3	3	3	3	3	1	5	5	5	5	8	8	1		
1912-13.....	3.96		3.96	3	8	3	3	3	0	0	0	0	0	0	0	0	0	0	14	14	14	14	14	13	13	9		
1913-14.....	9.20		9.20	0	0	0	0	0	0	0	0	0	10	10	10	8	8	8	4	6	6	6	6	0	0	13		
1914-15.....	5.26		5.26	0	3	0	0	0	0	0	0	0	1	1	1	2	2	2	4	4	4	4	4	9	9	16		
1915-16.....	9.77		9.77	13	7	7	7	7	7	5	5	12	7	7	7	5	5	5	10	16	16	16	16	12	9	13		
Average.....	6.38		6.38	6.56	6.63	6.63	6.63	6.63	3.75	1.25	1.25	5.00	3.08	3.08	4.20	4.20	4.20	7.73	8.44	8.44	8.44	8.44	9.63	11.33	9.89			
<b>102. Shade-free strain: Green grade--</b>																												
1911-12.....	199-7		682	8-14	31	21-12	78	70-0	239	45-1	149	11-5	43	17-9	60	2-13	11	4-9	16	7-10	25	0-6	1	3-9	11	5-15	18	
1912-13.....	452-4		593	5-0	17	7-0	24	4-9	15	45-12	170	38-5	154	36-10	149	15-0	64	0	0	0	0	0	0	0	0	2-3	6	
1913-14.....	4-4		13	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1-3	4	
1914-15.....	144-9		593	2-14	10	0-8	2	6-11	23	38-2	135	39-8	140	16-2	58	0-2	1	8-6	28	5-6	19	3-2	0	13	14	42	9-12	35
1915-16.....	128-8		450	14-4	52	37-7	132	15-7	56	15-11	57	9-11	37	4-4	15	8-10	27	8-15	31	3-13	14	4-0	13	2-1	8	2-5	8	
1916-17.....	47-10		176	1-4	5	1-0	4	2-7	9	5-9	21	7-1	26	5-2	20	6-9	24	9-12	34	2-10	10	6-4	23	0	0	0	0	
Average.....	112.44		402.83	6.45	23.00	13.54	48.00	19.83	98.40	30.04	106.40	47.73	67.00	43.28	56.33	5.51	24.17	5.47	18.75	3.85	13.29	2.03	6.80	5.59	18.00	3.84	13.00	



TABLE VIII.—Detailed statement of the annual performance of 24 representative lemon trees of the Eureka variety for the 6-year period from July, 1911, to June, 1917, inclusive—Continued.

Rank in Table VI, strain, grade, and season.	Total.		July.		August.		September.		October.		November.		December.		January.		February.		March.		April.		May.		June.			
	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.		
104. Pear-Shape strain— Continued.																												
Green grade—Con.																												
1914-15.....	61-9	296	1-8	6	3-2	13	7-2	28	3-0	12	4-7	16	9-9	36	1-10	6	12-10	44	1-0	4	3-6	12	9-9	32	4-10	17		
1915-16.....	103-10	376	0-8	1	2-15	11	10-6	41	1-1	48	0-12	3	2-3	8	2-5	8	8-1	27	16-7	60	12-7	45	8-1	31	25-13	93		
1916-17.....	29-15	118	2-3	10	2-0	9	1-12	7	1-0	4	2-11	11	3-10	15	1-6	5	5-6	20	8-10	33	1-0	4	0	4	0	0		
Average.....	57.13	210.67	1.65	6.40	2.35	9.60	5.51	21.26	9.46	35.00	5.93	22.40	11.69	41.80	3.31	12.60	7.59	26.75	5.93	21.83	4.89	18.00	4.11	14.60	6.46	23.40		
Tree-Ripe grade—																												
1911-12.....	74-4	337	0-4	2	0	0	0	0	0	0	0	0	0	0	5-4	23	36-7	176	12-6	54	0-14	5	0-9	2	2-13	15		
1912-13.....	31-10	168	0	0	0	0	0	0	0-6	2	0-10	4	11-0	54	19-1	105	0-9	3	0-3	1	0	0	0	0	0-12	3		
1913-14.....	0-15	4																										
1914-15.....	48-0	224	0	0	0	0-8	2	0	0	1-7	7	1-0	4	15-5	81	14-9	66	3-12	17	1-10	7	2-8	9	7-5	31			
1915-16.....	65-13	329	4-0	17	0-13	4	4	18	2-2	10	4-2	15	26-13	149	1-0	9	0-9	3	1-2	7	1-0	4	3-7	20	16-9	73		
1916-17.....	90-7	461	2-2	10	0-15	6	0	0	0-5	2	0-15	6	20-2	116	2-8	10	11-6	11	6-6	45	7-8	39	4-4	225	0-6	2		
Average.....	51.84	253.83	1.28	5.80	0.22	2.00	0.95	4.00	0.56	2.80	1.43	6.40	14.93	76.00	8.63	45.00	13.03	62.00	4.80	20.67	2.20	11.00	1.15	51.20	5.56	24.80		
Cull grade—																												
1911-12.....	6-7	53																										
1912-13.....	40-12	530	0	0	0-2	1	0	0	0-6	3	0-9	5	0-4	3	0-14	5	5-4	44	0-14	6	0-3	2	0-2	1	0	0		
1913-14.....	0	0																										
1914-15.....	8-2	56	0-3	2	0-2	1	0-8	3	0-2	1	0-2	1	0-3	1	0-6	5	1-2	8	1-1	8	0-8	3	0-11	5	3-2	18		
1915-16.....	12-10	86	0-4	1	0-7	3	0-10	4	1-5	9	0-11	3	0-6	3	0-10	5	3-6	30	3-0	1	0-6	1	0	7	2-12	14		
1916-17.....	13-9	120	0-8	3	0	0-4	3	0	0	0	0	0-9	6	0	6	0	2-12	20	2-12	25	3-12	41	3-0	22	22			
Average.....	13.68	140.83	0.24	1.50	0.17	1.25	0.34	2.50	0.45	3.25	0.34	2.25	0.34	3.25	0.47	4.00	12.08	148.50	0.81	5.83	0.89	7.20	1.11	10.80	1.78	10.80		
Total crop—																												
1911-12.....	191-1	786	3-12	15	3-7	14	6-15	26	19-12	73	16-1	58	49-1	172	10-2	40	51-6	256	26-0	107	1-1	7	0-11	3	2-13	15		
1912-13.....	106-13	833	0-9	2	0-6	2	1-6	5	10-4	43	6-14	33	20-15	95	26-5	138	39-2	515	0	0	0	0	0	0	2-10	10		
1913-14.....	4-12	17																										
1914-15.....	117-11	508	1-11	8	3-4	14	8-2	33	3-2	13	6-0	24	10-12	41	17-5	92	28-5	118	5-13	29	5-8	22	12-12	46	15-1	66		
1915-16.....	182-1	791	4-7	19	4-3	18	15-4	63	17-8	67	5-9	21	29-6	100	3-15	22	12-0	60	17-8	85	14-7	55	12-8	58	45-2	180		
1916-17.....	133-15	699	5-2	23	2-15	15	2-0	10	1-5	6	3-10	17	24-5	137	3-14	117	24-0	169	19-8	18	18-14	97	49-0	270	3-6	24		
Average.....	122.55	605.33	3.11	13.40	2.84	12.60	6.74	27.40	10.39	40.40	7.63	30.00	26.89	121.00	12.31	61.20	32.70	237.25	11.54	48.33	7.98	36.20	15.38	76.50	13.80	59.00		



BUD VARIATION IN THE EUREKA LEMON.

Variable fruits—	247	6	19	6	5	8	56	45	18	6	28	44
1914-15	433	12	34	28	6	76	3	17	25	25	28	163
1915-16	313	11	5	2	7	55	8			45	119	14
1916-17												
Average.....	331.00	14.33	19.33	12.00	6.00	46.33	22.33	20.67	22.67	25.33	58.67	73.67
Average seeds per fruit.....												
1911-12	0.94	1	0	0	0	0	0	0	0	11	0	4
1912-13	1.61	5	0	0	0	1	2	0	0			
1913-14	3.00	7	0	0	0	2	0	0	0			
1914-15	2.76	2	0	0	2	2	0	5	1	5	3	4
1915-16	4.75	8	2	4	2	4	4	11	5	4	6	3
Average.....	2.95	4.00	1.00	1.33	0.60	1.82	1.64	4.90	1.89	5.57	6.25	3.78
109. Shade-Tree strain:												
Green grade—												
1911-12	100-10	361 (1)	20	5-2	20	12-6	48	22-8	80	17-3	62	9-0
1912-13	86-12	360	0-11	0	0	14-8	51	21-5	93	29-6	117	20-4
1913-14	9-6	18										
1914-15	121-11	438	5-2	9	9-5	33	11-15	45	14-0	55	9-6	8
1915-16	129-10	482	1-15	4	16-14	62	16-8	60	17-12	65	9-12	37
1916-17	35-4	142	3-13	2	0	2-0	0	2-2	9	1-0	6	2-3
Average.....	79.89	300.17	2.89	11.00	4.20	15.54	42.40	15.54	60.40	12.58	48.60	6.79
Tree-Ripe grade—												
1911-12	22-8	94 (1)	0	0	0	0	0	1-2	4	0-15	4	0-6
1912-13	26-1	132	0	0	0	0	0	0-5	1	0-9	3	23-11
1913-14	0-4											
1914-15	20-10	89	0-3	1	0	0-8	3	0-11	4	0-14	4	4-1
1915-16	51-2	229	1-1	5	0-12	4	2-0	10	16-3	61	21-10	7
1916-17	7-1	34	0-6	2	0	0	0	0	0	0-9	3	0
Average.....	21.27	96.50	0.40	2.00	0.21	1.00	0.19	1.00	0.50	2.60	3.66	14.00
Cull grade—												
1911-12	7-1	43 (1)	0	0	0	0	0	0	0	0	0	0
1912-13	34-14	273	0	0	1	0-14	7	1-6	10	22-12	127	9-8
1913-14	0											
1914-15	3-4	21	0	0	0	0-6	2	0-8	4	0-5	2	0
1915-16	4-14	31	0	0	0	1-0-5	2	0-12	3	1-0	8	0-8
1916-17	9-13	75	0-10	5	0	0	0	0	1	0	0	0
Average.....	9.98	73.83	0.15	1.25	0.17	1.50	0.19	1.25	0.20	1.50	0.55	3.75
Total crop—												
1911-12	130-3	498 (1)	6-3	20	5-2	20	12-6	48	23-10	84	18-2	66
1912-13	147-11	765	0-11	4	0-3	2	14-10	52	22-8	101	31-5	130
1913-14	5-10	19										
1914-15	146-9	548	5-5	19	2-6	9	9-14	36	12-13	51	15-3	63
Average.....	146-9	548	5-5	19	2-6	9	9-14	36	12-13	51	15-3	63
Total crop—												
1911-12	130-3	498 (1)	6-3	20	5-2	20	12-6	48	23-10	84	18-2	66
1912-13	147-11	765	0-11	4	0-3	2	14-10	52	22-8	101	31-5	130
1913-14	5-10	19										
1914-15	146-9	548	5-5	19	2-6	9	9-14	36	12-13	51	15-3	63
Average.....	146-9	548	5-5	19	2-6	9	9-14	36	12-13	51	15-3	63

1 This tree was added to the plot in August, 1911.





TABLE VIII.—Detailed statement of the annual performance of 24 representative lemon trees of the *Eureka* variety for the 6 year period from July, 1911, to June, 1917, inclusive—Continued.

Rank in Table VI, strain, grade, and season.	Total.		July.		August.		September.		October.		November.		December.		January.		February.		March.		April.		May.		June.		
	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	Weight.	Number.	
117. Dense-Unproductive strain: 1																											
Green grade—																											
1912-13.....	19-3	80																									
1913-14.....	11-13	39																									
1914-15.....	43-10	150	4-10	17	1-12	7	4-12	16	2-5	9	6-4	21	1-4	4	0	0-5	1	0-14	3	2-10	9	8-12	29	10-2	34		
1915-16.....	49-2	177	3-13	14	10-14	40	6-7	23	17-12	62	0	2	0	2	7	0-4	1	0-15	3	2-3	10	2-3	8	1-6	5		
1916-17.....	13-12	54	3-2	12	0-8	2	0-4	1	0	0	1-4	5	3-6	15	0	4	1	1-14	7	0-8	2	2-10	9	0	0		
Average.....	27.50	100.00	3.85	14.33	4.38	16.33	3.81	13.33	6.69	23.67	1.94	6.75	2.76	10.40	2.58	11.40	0.42	1.33	0.82	3.33	1.33	4.75	4.66	15.25	4.19		
Tree-Ripe grade—																											
1912-13.....	17-7	87																									
1913-14.....	1-8	6																									
1914-15.....	3-10	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
1915-16.....	38-14	170	0-2	1	1-0	5	2-8	13	3-0	14	12-6	43	18-14	87	0-13	6	0	0	0	0	0	0	0	0	0		
1916-17.....	11-12	51	0-11	4	0	0	0	0	0	0-7	2	0-3	1	3-5	16	0-4	1	1	1	1	1	1	1	1	1		
Average.....	14.64	65.80	0.27	1.67	0.33	1.67	0.83	4.33	1.15	5.33	3.14	11.00	4.68	21.80	3.19	16.40	1.06	4.67	0.22	0.67	0.95	3.75	1.17	4.75	0.14		
Cull grade—																											
1912-13.....	38-13	348																									
1913-14.....	0	0																									
1914-15.....	1-3	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
1915-16.....	2-10	23	0	0	0-7	8	0-3	1	0-3	1	0-4	1	0-6	2	0	0	0	0	0	0	0	0	0	0	0		
1916-17.....	2-13	20	0-5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Average.....	9.09	79.40	0.10	0.67	0.15	2.67	0.06	0.33	0.06	0.33	0.06	0.25	0.90	4.80	3.53	21.00	6.04	75.67	0.04	0.17	0.06	0.75	0.36	2.00	0.47		
Total crop—																											
1912-13.....	75-7	515																									
1913-14.....	13-5	45																									
1914-15.....	48-7	171	4-10	17	1-12	7	4-12	16	2-5	9	6-4	21	1-11	6	0	0	0	0	0	0	0	0	0	0			
1915-16.....	90-10	367	3-15	15	12-5	53	9-2	37	20-15	77	12-10	44	21-6	96	1-1	7	1-5	5	2-3	10	2-3	8	1-15	8			
1916-17.....	28-5	128	4-2	18	0-8	2	0-4	1	0-7	2	1-7	6	6-11	31	0-10	3	0	0	0	0	0	0	0	0			
Average.....	51.23	245.20	4.22	16.67	4.85	20.67	4.71	18.00	7.90	29.33	5.14	18.00	8.34	37.00	9.29	48.80	7.52	81.67	1.08	4.17	2.34	9.25	6.19	22.00	4.80		



The notes that follow regarding some of the methods of recording and compiling the data presented in Table VIII may assist the reader to understand and interpret it.

The continuity of the records on this plat was badly disturbed by the severe freeze in the early part of January, 1913. It will be noted in Table VIII that no pickings were made from February to November, 1913. In summarizing the records it has been considered that all the trees were affected to practically the same degree, and the crops recorded during this experiment have been credited as the production for the 6-year period. This procedure necessarily results in a decreased average annual yield as an index of the performance of the individual trees. However, this is not a serious matter, inasmuch as these studies are based primarily upon the relative character and behavior of the various strains, and their differences are as apparent during periods of unfavorable conditions as at times when production is normal.

Spaces left blank in these records indicate that no fruit was picked at that time. The absence of fruit of any special grade or of seeds at any time when a picking was made is indicated by zero.

The fruits of the Cull grade were not recorded separately until February, 1912. Previous to that time they had been included with those of the Tree-Ripe grade, and it is not possible to separate them.

In endeavoring to make pickings every month, unavoidable delays were sometimes occasioned by unfavorable conditions of climate, by interfering periods of irrigation, or from other causes. In this way it sometimes happened that the interval between pickings was considerably prolonged beyond the 30-day schedule time. Because of the longer time required to secure the records at seasons when the crop was increasing in amount it was necessary to begin the picking a few days in advance of the corresponding date in the previous month. Unfavorable weather conditions during the winter season often delayed the progress of the work from a day to a week at a time so that during that period it was usually necessary to keep at the record work continuously in order to forestall unforeseen delays and interruptions. The ideal way to obtain data such as these would be to determine the number of days required to make the records at the season when the crops were lightest, then to have a sufficient number of trained men available so that the work could be begun on the corresponding date each month and completed in the same minimum number of days, regardless of the weather or other unfavorable conditions. However, this ideal is impossible of attainment under practical conditions.

Table IX records the first and last dates of each period for picking lemons on the Eureka study plat. As already stated, no records were made from February to November, 1913, on account of the

injury occasioned by the freeze in January of that year. In February, 1914, and again in February, 1917, unavoidable conditions delayed the work so that no pickings were made for about 45 days.

TABLE IX.—*Dates on which fruit was picked from the lemon trees of the Eureka variety in the investigational performance-record plat from July, 1911, to June, 1917, inclusive.*

Month.	First and last date of each picking period.					
	1911-12	1912-13	1913-14	1914-15	1915-16	1916-17
July.....	July 5 to 12..	July 1 and 2..	.....	July 9 to 14..	July 21 to 23.	Aug. 1 and 2.
August.....	Aug. 1 to 7...	Aug. 1 to 3...	.....	Aug. 5 and 6..	Aug. 27 to 31.	Sept. 4 and 5.
September...	Aug. 28 to Sept. 5.	Aug. 26 to 27.	.....	Sept. 8 to 10..	Sept. 23 to 27.	Oct. 3 and 4.
October.....	Oct. 2 to 10..	Oct. 1 to 9....	.....	Oct. 9 to 13..	Oct. 25 to 28.	Oct. 27 to 30.
November.....	Nov. 3 to 10..	Nov. 1 to 6....	Nov. 5 and 6..	Nov. 7 to 17..	Nov. 23 to 27.	Nov. 28 and 29
December.....	Dec. 4 to 11..	Dec. 2 to 6....	Dec. 15.....	Dec. 14 to 21.	Dec. 20 to 28.	Jan. 2 and 5..
January.....	Jan. 3 to 6....	Jan. 2 to 13..	Jan. 23.....	Jan. 1 to 6....	Jan. 26 to Feb. 1.	Jan. 31 and Feb. 1.
February.....	Feb. 1 to 7....	Feb. 2 to 18..	.....	Feb. 12 to 19.	Feb. 25 to Mar. 3.	.....
March.....	Mar. 2 to 15..	.....	Mar. 10 to 11.	Mar. 8 to 12..	Mar. 23 to 27..	Mar. 16 to 20
April.....	Apr. 1 to 3....	.....	Apr. 4 to 7....	Apr. 6 to 12..	Apr. 25 to May 2.	Apr. 17 to 19.
May.....	May 3 to 6....	.....	May 20 to 22..	May 14 to 19..	May 25 to 31..	May 26 to 29.
June.....	May 30 to June 1.	.....	June 13 to 16.	June 18 to 21.	June 27 to 30.	June 30 to July 2.

The excessive number of fruits of the Cull grade recorded in January and February, 1913, was largely the result of injury by the January freeze. All the small fruit on the trees at that time was badly frozen, so that there was nothing to be picked for several months afterward, and all the frozen fruit was recorded as of the Cull grade.

Variable fruits were first recorded in September, 1912. Because of the interruption to the records occasioned by the freeze of the following January and the subsequent period during which no fruit was picked from these trees, the data presented for the variable fruits are confined to the three years from July, 1914, to June, 1917, inclusive. In counting the variable fruits found on the different trees the typical fruit for the variety is made the standard, and all variations from it are recorded. This practice has been followed with all the trees, even those of the Pear-Shape strain.

In explanation of the relatively large number of variable fruits recorded from many of the trees, even of the Eureka strain, it should be said that several of the forms listed vary but slightly from the typical fruit of the variety. In fact, it is believed that some of these forms are continuous variations of fluctuations induced to some extent by certain climatic conditions, and they are characteristic to a greater or less degree of all lemon trees, so far as studied. Three such forms have been designated as collared, protruding blossom end, and ridged. On nearly all the trees under observation from 75 to 90 per cent of the fruits recorded as variable have been of these classes. The more marked variations which show a greater departure from the type of the different varieties, and those forms which have been

proved to be true bud mutations usually appear more frequently and more abundantly in trees of some of the unproductive or otherwise undesirable strains than they do in trees of the standard strain of the variety.

The presence of variable fruits on all the trees and the fact that some trees produce many more such fruits than other trees emphasize the need of having reliable individual-tree performance records for use as a basis in selecting trees from which bud wood can be taken for commercial propagations. It is not sufficient to know that certain trees produce heavy crops, but data must be available to show the number and kind of variations on the trees, so that only those will be chosen which bear the most uniform and desirable fruit.

In Table X are presented the total number of the different variable forms which were recorded for three years on the trees listed in Table VIII. The typical fruits of the Pear-Shape strain produced on the trees listed in ranks 71 and 104 are recorded as bottle shaped, and other fruits on the same trees having a tendency toward that typical shape are classed as collared. These collared fruits are believed to be of a different character from the collared fruits commonly found on trees of other strains, but being like them in appearance they were listed in the same class. Propagations have been made to determine this point.

Wherever no record was made of any factor for one or more months it is thought that the most practicable method of computing the monthly averages in Table VIII is by dividing the monthly totals by the number of months represented in each total. For example, the averages for the production of Green-grade fruit by the tree in rank 1 in Table VIII during July, August, September, and October were computed by dividing the monthly totals by the factor 5, as there are records for five years during those months. In November, December, and January the records for six years are available. In February the pickings were missed in 1914 and 1917 and the average for that month is obtained by using the factor 4. In March records were secured during five years but the crops harvested in that month in 1914 and 1917 were in reality the yields for two months in each case, so the factor 7 has been used in determining the average for that month. It is recognized that this resulting average is not strictly accurate, but it is believed to represent more nearly the correct average for the period than any other figure that can be presented in this table. Because of the use of different factors, as just mentioned, the totals of the monthly averages are not equivalent to the average for the yearly totals. Other instances in this and other tables will be found where the decimal portions of averages of total records do not exactly correspond with the totals of the averages of the corresponding numbers. This is due to the small errors occasioned by the practice of retaining only two decimal places in average figures.



TABLE X.—Number of variable fruits of different forms produced during the 3-year period from July, 1914, to June, 1917, inclusive, on the 24 individual lemon trees of the Eureka variety listed in Table VIII.

[The several trees are designated by numbers denoting their rank (as shown in Table VIII), the strain to which each belongs being indicated by abbreviations, as follows: DP=Dense Productive, DU=Dense Unproductive, E=Eureka, PS=Pear Shape, SO=Small Open, ST=Shade Tree.]

Description of fruit variations.	Tree designations by rank and strain.											
	1, E.	9, E.	17, E.	22, SO.	26, L.	27, DP.	35, E.	43, E.	52, E.	60, E.	63, ST.	66, DP.
Collared.....	174	28	42	159	36	142	113	36	20	23	40	77
Protruding blossom end.....	195	102	55	189	121	193	59	83	69	152	159	131
Collared and protruding.....	63	14	7	111	26	81	38	17	6	23	33	35
Bottle shaped.....	1						1					
Raised section.....	6	2	2	25	1	2	2	2	1	5	4	2
Raised ridge.....	14	25	29	67	23	24	29	13	18	15	31	14
Ridged.....	62	48	27	95	43	58	66	18	18	18	25	47
Ridged and collared.....	5		3	6	4	8	3	2	3	3	12	9
Ridged and protruding.....	20	24	18	20	19	37	27	8	3	14	26	25
Ridged, collared, and protruding.....	3	5	3	5	2	9	8	1	2	7	12	2
Sunken section.....	1			12		1	1				1	1
Creased.....	27	5	4	43	6	12	12	12	3	6	14	12
White section.....				1								
Raised white section.....				1								
Sunken white section.....	1			5								
Striped.....			1	6							2	
Ribbed.....				24				1		1	1	
Corrugated.....				12				1			4	
Abnormal shape.....				1		3						2
Miscellaneous variations.....	6	2		16	2	2	2	4	2	1	8	3
3-year totals.....	578	255	191	798	283	572	361	198	145	258	372	360
Percentage of total crop.....	11.4	6.0	4.7	20.5	8.9	13.3	9.5	6.7	4.4	9.8	13.8	11.2

Description of fruit variations.	Tree designations by rank and strain.											
	71, PS.	72, E.	81, SO.	88, E.	93, ST.	95, DU.	99, SO.	102, ST.	104, PS.	109, ST.	112, DU.	117, DU.
Collared.....	868	120	20	44	54	34	41	76	613	103	105	40
Protruding blossom end.....	14	98	48	85	103	123	82	50	6	5	16	12
Collared and protruding.....	22	47	5	6	37	41	5	14	15	11	10	2
Bottle shaped.....	466							1	286		1	
Raised section.....		2	1		3	2	1	1			1	1
Raised ridge.....	5	8	13	27	25	16	16	2	4	9	9	2
Ridged.....	4	75	40	28	27	28	23	41	1	79	27	13
Ridged and collared.....	1	5	6	1	3	3	3	17		19	27	5
Ridged and protruding.....		18	16	7	34	43	14	10		21	11	3
Ridged, collared, and protruding.....	1	7	3	1	10	33	2	4	1	7	4	4
Sunken section.....	1					1				1		
Creased.....	17	9	10	4	6	6	11	16	6	6	12	7
White section.....												
Raised white section.....						1						
Sunken white section.....					1							
Striped.....	176								61			
Ribbed.....										1		
Corrugated.....					10	3					1	
Abnormal shape.....						1	1	6				
Miscellaneous variations.....	1	2	3	5	3	8	2	13		8	18	
3-year totals.....	1576	391	165	208	316	343	201	251	993	270	242	89
Percentage of total crop.....	50.4	15.8	6.4	6.9	15.4	16.2	8.5	18.0	49.7	17.5	18.8	13.4

A study of the number of seeds produced by the individual trees was made by cutting one typical fruit of each of the Green grade, the Tree-Ripe grade, and the Cull grade from each tree at each picking up to June, 1916, at which time these records were discontinued. In case one or more grades of fruit was not represented at any picking no substitution was made in determining the seed content. Nor-

mally, each figure recorded in Table VIII under this heading is the average of three fruits, but in some instances it has been secured from one or two fruits. The total averages shown for each month, those for each season, and those for the five years were obtained by factoring the total number of seeds and the number of fruits examined for that purpose during the period indicated rather than by averaging the monthly averages.

The average number of seeds per fruit indicated by this method varies considerably from the true average of all the fruits produced. There is a considerable variation in seed content on the trees of many of the strains between the fruit produced during different months. Fruit production is much heavier in certain months than during other months, while in the system of averaging here used, which was the only practicable one under the circumstances, equal weight is given to the seed data for each month.



FIG. 10.—Diagram showing the average annual total crops and the amounts of fruit of the different commercial grades produced by the trees of the several strains of Eureka lemons occurring in the investigational performance-record plat during the 6-year period from July, 1911, to June, 1917, inclusive. The strains are ranked according to the weight of their average total crops.

Table XI shows the average annual crops of the individual Eureka lemon trees in the investigational performance-record plat, arranged in groups of strains and of select trees within some of the strains. The strains are listed in the order of their rank by total crops by weight, and the production of fruit of the different grades is also shown. These averages are shown graphically in figure 10. Several of the strains are represented by different numbers of individuals, so no exact comparisons can be drawn between them. However, as in nearly every case the trees within each strain have shown a considerable degree of uniformity with respect to their various characteristics, the data shown in this and the following tables are thought to be fairly indicative of the relative values of the different strains represented.

Table XI shows the trees of the Eureka strain to be more productive than those of any other in the list, with an average annual production of 230 pounds for the 6-year period. Of the Eureka trees

in the plat, 35 were above this average and 41 below it, as shown in Table VI. The limits of the average individual-tree production within the strain were 338.24 pounds and 165.86 pounds, being 108.21 pounds (or 47.1 per cent) above the mean and 64.17 pounds (or 27.9 per cent) below it, respectively. In each of the other strains represented by 10 or more individuals, the individual-tree variations are also considerably greater above the mean than below it.

TABLE XI.—Average annual crop of the individual lemon trees of several of the important strains found in the investigational performance-record plat of the Eureka variety, ranked according to the weight of their average total crops, for the 6-year period from July, 1911, to June, 1917, inclusive.

Number of trees.	Description of trees.	Average annual production per tree.							
		Total crop.		Green grade.		Tree-Ripe grade.		Cull grade.	
		Pounds.	Number.	Pounds.	Number.	Pounds.	Number.	Pounds.	Number.
10	Highest producing (all Eureka strain).....	299.45	1,341.83	201.71	754.00	63.83	292.65	33.92	295.18
76	Eureka strain.....	230.03	1,051.88	144.63	541.58	57.20	263.29	28.20	247.01
2	Dense-Productive strain...	217.55	980.83	155.67	576.83	39.85	183.75	22.03	220.25
117	Entire plat.....	200.39	902.91	131.58	490.16	46.17	212.07	22.63	200.68
10	Small-Open strain.....	179.86	808.88	119.07	445.68	41.43	188.70	19.36	174.50
2	Pear-Shape strain.....	153.72	721.25	87.69	328.58	52.80	264.50	13.23	128.17
17	Shade-Tree strain.....	144.79	597.33	117.17	426.93	18.00	79.47	9.62	90.93
10	Dense-Unproductive strain	96.09	405.00	73.42	266.30	14.93	66.82	7.74	71.88
10	Lowest producing (irrespective of strain).....	89.44	379.42	68.46	250.25	13.48	60.83	7.50	68.33

Table XII shows the percentage of fruit of the three commercial picking grades produced by the trees of the various Eureka strains, together with the average number and percentage of variable fruits recorded in each strain. The strains are here listed in the order of their rank by percentages of fruit of the Green grade produced per tree. The Shade-Tree, Dense-Unproductive, and Dense-Productive strains rank considerably above the others under this classification. However, it should be remembered that while in general fruit of the Green grade is superior to that of the Tree-Ripe grade, the fruit of the three strains just mentioned is much inferior in texture, thickness of skin, and other characteristics to that of the Eureka strain; hence, the superiority which would appear to be indicated by a study of this table alone is entirely lost when consideration is given to the character of the fruit itself.

While the trees of the Small-Open strain are shown to have produced a slightly higher percentage of Green-grade fruit than the trees of the Eureka strain, the actual production of the trees of the Small-Open strain is so much less than that of those of the Eureka strain that the inferiority of that strain is very apparent. The decreased percentage of Cull-grade fruit produced by the trees of the Shade-Tree, Dense-Unproductive, and Dense-Productive strains is

probably due to the closer habit of growth of those trees, which lessens the number of fruits knocked from the trees or marred and scratched by the movement of the branches by the wind. The more compact trees also protect their fruits from sunburn to a greater extent than those of a more open character.

As shown by the last two columns in Table XII and graphically in figure 11, the fruit produced by the trees of the Eureka strain is more uniform in character than that borne on the trees of the other strains. The 7.68 per cent of variable fruit produced by the trees of the Eureka strain seems large, but the number is much less than was produced by the trees of the other strains, and if the minor forms and fluctuating variations were deducted this percentage would be very greatly reduced.

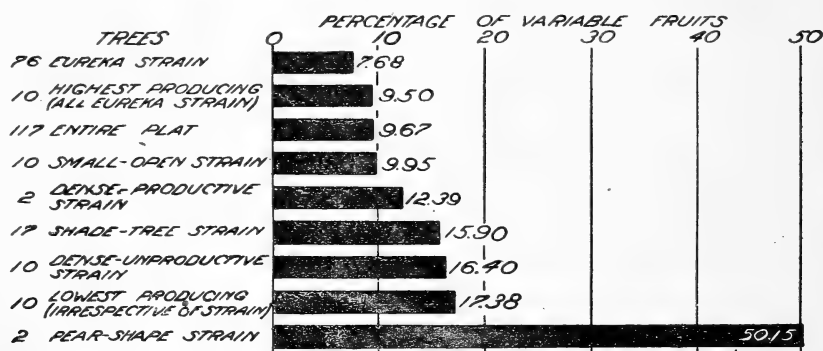


FIG. 11.—Diagram showing the percentages of variable fruits occurring on the trees of the different strains of Eureka lemons in the investigational performance-record plat during the 3-year period from July, 1914, to June, 1917, inclusive. The proportions are based on the number of fruits produced.

TABLE XII.—Production of fruit of the three different grades and of variable fruits picked from the lemon trees of the several strains of the Eureka variety in the investigational performance-record plat during the 6-year period from July, 1911, to June, 1917, inclusive.

[The data for variable fruits cover the 3-year period from July, 1914, to June, 1917, inclusive. The strains are ranked according to their proportion (by weight) of fruit of the Green grade.]

Number of trees.	Description of trees.	Percentage of weight of total crop.			Variable fruits.	
		Green grade.	Tree-Ripe grade.	Cull grade.	Average yearly number per tree.	Per cent.
17	Shade-Tree strain.....	80.92	12.43	6.65	99.84	15.90
10	Lowest producing (irrespective of strain).....	76.54	15.07	8.39	69.00	17.38
10	Dense-Unproductive strain.....	76.40	15.54	8.06	68.77	16.40
2	Dense-Productive strain.....	71.56	18.32	10.13	155.33	12.39
10	Highest producing (all Eureka strain).....	67.36	21.32	11.33	148.53	9.50
10	Small-Open strain.....	66.20	23.03	10.77	93.77	9.95
117	Entire plat.....	65.66	23.04	11.29	95.68	9.67
76	Eureka strain.....	62.87	24.87	12.26	88.16	7.68
2	Pear-Shape strain.....	57.04	34.35	8.61	428.17	50.15

TABLE XIII.—Average yields and percentages of total yield of fruit of the Green and Tree-Ripe grades picked each month from the lemon trees of the various strains of the Eureka variety in the investigational performance-record plot during the 3-year period from July, 1914, to June, 1917, inclusive.

[The strains are listed in the order of their total-production rank for six years, as shown in Table X.]

Description of trees.	Number of trees.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Season.
<b>PRODUCTION (IN POUNDS) AVERAGE.</b>														
<b>Green grade:</b>														
Highest producing (all Eureka strain).....	10	8.47	6.82	13.09	13.90	17.43	32.01	10.01	37.20	41.55	47.76	35.89	8.13	272.26
Eureka strain.....	76	5.64	4.67	8.14	9.78	9.08	17.97	5.21	20.19	25.30	35.40	30.67	8.05	180.11
Dense-Productive strain.....	2	8.18	5.38	12.95	10.36	15.99	22.91	10.13	31.59	37.05	42.63	27.15	6.80	231.10
Entire plot.....	117	5.71	5.87	9.09	10.89	10.59	16.24	4.96	17.27	20.83	28.57	25.35	7.21	162.60
Small-Open strain.....	10	5.75	4.45	7.18	8.00	9.28	14.90	4.80	17.78	21.43	26.17	26.58	7.48	153.79
Pear-Shape strain.....	2	3.74	7.65	13.28	12.48	12.79	16.36	3.02	7.54	5.99	7.57	6.65	6.51	103.58
Shade-Tree strain.....	17	6.67	11.26	13.65	18.69	18.54	13.90	4.99	9.93	9.16	12.16	11.19	4.67	134.81
Dense-Unproductive strain.....	10	4.49	6.98	8.84	8.82	8.33	6.96	2.84	6.10	5.77	8.35	11.10	5.13	83.69
Lowest producing (irrespective of strain).	10	3.95	7.44	9.59	10.63	10.13	7.24	2.52	5.49	5.50	7.74	7.29	4.03	81.56
<b>Tree-Ripe grade:</b>														
Highest producing (all Eureka strain).....	10	1.56	1.28	1.07	1.65	3.75	19.91	4.99	10.19	8.89	13.34	23.91	4.50	95.05
Eureka strain.....	76	1.66	1.14	.90	1.61	4.04	13.72	3.59	9.24	6.78	10.23	23.48	5.56	81.94
Dense-Productive strain.....	2	.99	.59	.54	.72	4.95	12.88	2.67	7.48	7.42	9.66	14.98	3.04	65.91
Entire plot.....	117	1.36	.94	.81	1.37	3.96	11.96	2.96	7.26	5.41	7.96	18.07	4.36	66.43
Small-Open strain.....	10	2.05	.96	.72	1.07	3.83	10.53	2.75	6.85	5.89	7.90	16.33	4.81	63.70
Pear-Shape strain.....	2	1.51	.65	1.26	1.56	7.57	32.33	3.80	3.98	2.68	3.09	12.58	4.65	75.67
Shade-Tree strain.....	17	.28	.47	.49	.82	3.56	6.66	1.28	2.21	1.64	2.12	4.43	.88	24.85
Dense-Unproductive strain.....	10	.28	.34	.64	.91	3.26	4.85	1.13	1.94	1.07	1.24	3.70	.84	20.19
Lowest producing (irrespective of strain).	10	.23	.29	.64	.90	3.30	5.07	.86	1.35	.81	1.08	2.43	.36	17.31
<b>PERCENTAGE OF WEIGHT OF TOTAL CROP.<sup>1</sup></b>														
<b>Green grade:</b>														
Highest producing (all Eureka strain).....	10	3.1	2.5	4.8	5.1	6.4	11.8	3.7	13.7	15.3	17.5	13.2	3.0	21.8
Eureka strain.....	76	3.1	2.6	4.5	5.4	5.0	10.0	2.9	11.2	14.1	19.7	17.0	4.5	27.2
Dense-Productive strain.....	2	3.5	2.3	5.6	4.5	6.9	9.9	4.4	13.7	16.0	18.4	11.8	2.9	20.5
Entire plot.....	117	3.5	3.6	5.6	6.7	6.5	10.0	3.1	10.6	12.8	17.6	15.6	4.4	27.1
Small-Open strain.....	10	3.7	2.9	4.7	5.2	6.0	9.7	3.1	11.6	13.9	17.0	17.3	4.9	28.8
Pear-Shape strain.....	2	3.6	7.4	12.8	12.0	12.3	15.8	2.9	7.3	5.8	7.3	6.4	6.3	23.7
Shade-Tree strain.....	17	4.9	8.4	10.1	13.9	13.8	10.3	3.6	7.4	6.8	9.0	8.3	3.5	25.1
Dense-Unproductive strain.....	10	5.4	8.3	10.6	10.5	9.9	8.3	3.4	7.3	6.9	10.0	13.3	6.1	33.1
Lowest producing (irrespective of strain).	10	4.8	9.1	11.8	13.0	12.4	8.9	3.1	6.7	6.7	9.5	8.9	4.9	27.7
<b>Tree-Ripe grade:</b>														
Highest producing (all Eureka strain).....	10	1.6	1.3	1.1	1.7	4.0	21.0	5.3	10.7	9.4	14.0	25.2	4.7	32.8
Eureka strain.....	76	2.0	1.4	1.1	2.0	4.9	16.7	4.4	11.3	8.3	12.5	28.6	6.8	38.8
Dense-Productive strain.....	2	1.5	.9	.8	1.1	7.5	19.5	4.0	11.4	11.3	14.7	22.7	4.6	29.7
Entire plot.....	117	2.0	1.4	1.2	2.1	6.0	18.0	4.5	10.9	8.2	12.0	27.2	6.6	37.2
Small-Open strain.....	10	3.2	1.5	1.1	1.7	6.0	16.5	4.3	10.7	9.2	12.4	25.6	7.6	37.9
Pear-Shape strain.....	2	2.0	.8	1.7	2.1	10.0	42.7	5.0	5.3	3.5	4.1	16.6	6.1	25.5
Shade-Tree strain.....	17	1.1	1.9	2.0	3.3	14.3	26.8	5.2	8.9	6.6	8.5	17.9	3.5	24.4
Dense-Unproductive strain.....	10	1.4	1.7	3.2	4.5	16.2	24.0	5.6	9.6	5.3	6.1	18.3	4.2	25.6
Lowest producing (irrespective of strain).	10	1.3	1.7	3.7	5.2	19.1	29.3	5.0	7.8	4.7	6.3	14.0	2.1	19.1

<sup>1</sup> The season percentage is calculated on the production for the four months, May to August, inclusive.

In Table XIII and in figures 12, 13, and 14 are shown some of the recorded differences in season of production of fruits of the Green and Tree-Ripe grades by the Eureka lemon trees of the various strains. On account of the interruption to regular picking which resulted from the freeze in January, 1913, only the three years from July, 1914,

to June, 1917, inclusive, have been considered in this study. During this period pickings were made every month except in February, 1917, when interfering rains made it impossible to do the work at the scheduled time. Inasmuch as it would be unfair to consider the fruit picked in March, 1917, as all produced during one month, it was decided that for the purpose of this comparison of seasonable production the crops picked at that time should be arbitrarily halved and credited to February and March equally.

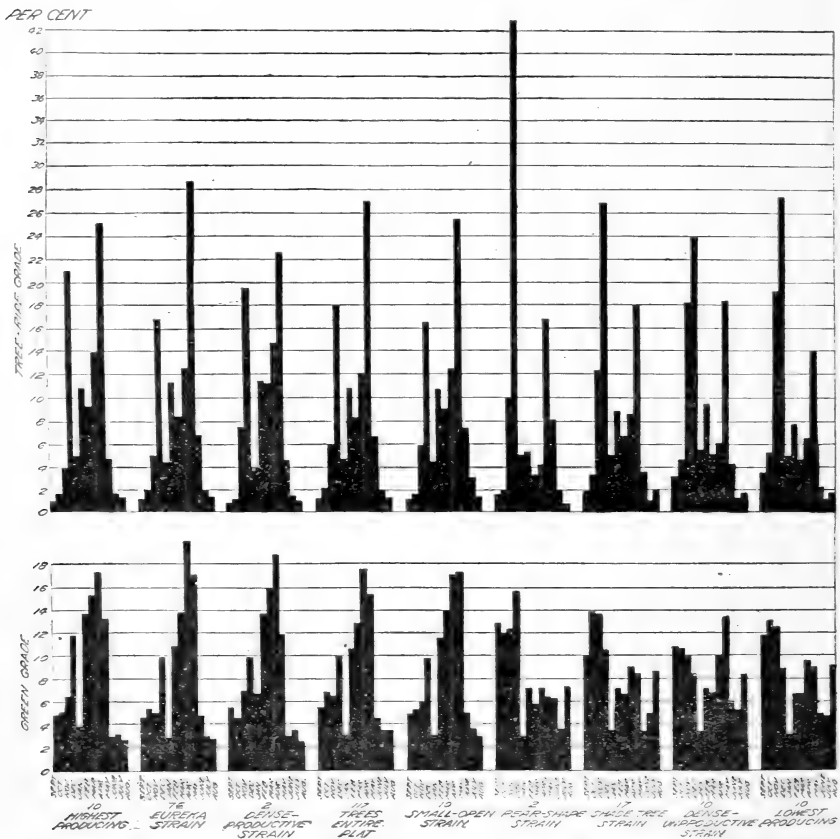


FIG. 12.—Diagram showing the percentages of the total yields of Green-grade fruits and of Tree-Ripe fruits, by weight, produced each month by the trees of the various strains of Eureka lemons in the investigational performance-record plot during the 3-year period from July, 1914, to June, 1917, inclusive. The strains are arranged from left to right in the order of their rank for total production, as shown in Table X.

The first part of Table XIII shows the average individual-tree production of fruit of the Green and Tree-Ripe grades for each month, expressed in pounds. The comparative behavior of each strain in this respect is best studied by expressing the monthly yields in percentages of the annual crop, and these data are given in the second part of the table, and are shown graphically in figures 12 and 13.

In choosing between lemon trees which were alike in all other respects, that one would be considered the most desirable which produced the largest quantity of fruit of the Green grade during May, June, July, and August. The summer heat causes a considerably increased consumption of lemons, resulting normally in a higher price being paid for them, especially in the late summer when the supply is greatly reduced. Hence it will be understood that, other things being equal,

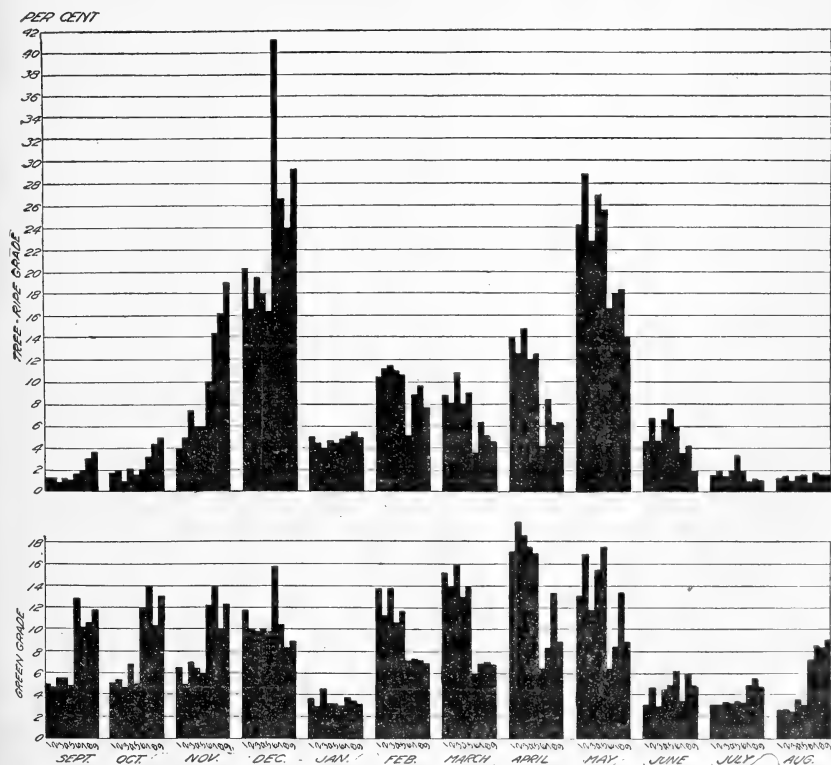


FIG. 13.—Percentages of the total yields of fruits of the Green and the Tree-Ripe grades, by weight, produced each month by the trees of the various strains of Eureka lemons in the investigational performance-record plat during the 3-year period from July, 1914, to June, 1917, inclusive. The data here presented are the same as those presented in figure 12, being here rearranged to show more clearly the variations between the different strains each month. The strains are listed from left to right in the same order as in figure 12. Arrangement of strains: 1, Ten highest producing trees; 2, 76 trees of the Eureka strain; 3, 2 trees of the Dense-Productive strain; 4, 117 trees, entire plat; 5, 10 trees of the Small-Open strain; 6, 2 trees of the Pear-Shape strain; 7, 17 trees of the Shade-Tree strain; 8, 10 trees of the Dense-Unproductive strain; 9, 10 lowest producing trees.

the most valuable variety or strain for the grower will be that one which produces the larger proportion of its fruit in the late spring and summer. Such fruit can be shipped immediately after it has been cured, and under normal conditions it will bring satisfactory prices.

Fruit of the Green grade is normally picked only when it has reached a certain diameter. In practice this size sometimes varies at different seasons or on account of changed market requirements, and in

securing the investigational performance records the same standard of picking was followed each month as that used in the regular commercial picking. Table XIV shows the ring size used for Green-grade fruit at each picking from July, 1911, to June, 1917, inclusive. Fortunately for this study of seasonal variation, it will be noted that there was no change in ring size during the last two years of the study period. Fruit of the Tree-Ripe grade is sometimes picked as soon as it appears, and sometimes it is not picked until it reaches a certain size, which is usually smaller than the standard being used for fruit of the Green grade. The practice varies in different orchards, and in any one orchard it is usually influenced by climatic and market conditions. On this account it is believed that a consideration of the fruit of the Green grade alone will give the truest index of the production habit of the various strains but the data for the fruit of the Tree-Ripe grade are included as a matter of interest.

TABLE XIV.—*Diameter of rings used in picking fruits of the Green grade from the lemon trees of the Eureka variety in the investigational performance-record plat during the 5-year period from July, 1912, to June, 1917, inclusive.*

Month.	Diameter of picking ring for Green-grade fruit (inches).						Month.	Diameter of picking ring for Green-grade fruit (inches).					
	1911-12	1912-13	1913-14	1914-15	1915-16	1916-17		1911-12	1912-13	1913-14	1914-15	1915-16	1916-17
July.....	2 $\frac{3}{8}$	2 $\frac{3}{8}$	.....	2 $\frac{3}{8}$	2 $\frac{3}{8}$	2 $\frac{3}{8}$	January.....	2 $\frac{3}{8}$	2 $\frac{3}{8}$	2 $\frac{1}{2}$	2 $\frac{1}{2}$	2 $\frac{3}{8}$	2 $\frac{3}{8}$
August.....	2 $\frac{3}{8}$	2 $\frac{3}{8}$	.....	2 $\frac{3}{8}$	2 $\frac{3}{8}$	2 $\frac{3}{8}$	February.....	2 $\frac{3}{8}$	2 $\frac{3}{8}$	.....	2 $\frac{1}{2}$	2 $\frac{3}{8}$	.....
September.....	2 $\frac{3}{8}$	2 $\frac{3}{8}$	.....	2 $\frac{3}{8}$	2 $\frac{3}{8}$	2 $\frac{3}{8}$	March.....	2 $\frac{3}{8}$	.....	2 $\frac{1}{2}$	2 $\frac{1}{2}$	2 $\frac{3}{8}$	2 $\frac{3}{8}$
October.....	2 $\frac{3}{8}$	2 $\frac{3}{8}$	.....	2 $\frac{3}{8}$	2 $\frac{3}{8}$	2 $\frac{3}{8}$	April.....	2 $\frac{3}{8}$	.....	2 $\frac{3}{8}$	2 $\frac{3}{8}$	2 $\frac{3}{8}$	2 $\frac{3}{8}$
November.....	2 $\frac{3}{8}$	2 $\frac{3}{8}$	2 $\frac{1}{2}$	2 $\frac{3}{8}$	2 $\frac{3}{8}$	2 $\frac{3}{8}$	May.....	2 $\frac{3}{8}$	.....	2 $\frac{3}{8}$	2 $\frac{3}{8}$	2 $\frac{3}{8}$	2 $\frac{3}{8}$
December.....	2 $\frac{3}{8}$	2 $\frac{3}{8}$	2 $\frac{1}{2}$	2 $\frac{3}{8}$	2 $\frac{3}{8}$	2 $\frac{3}{8}$	June.....	2 $\frac{3}{8}$	.....	2 $\frac{3}{8}$	2 $\frac{3}{8}$	2 $\frac{3}{8}$	2 $\frac{3}{8}$

In figure 12 the graphs representing the monthly production of fruit of the Green and Tree-Ripe grades are arranged by strains from left to right, according to their rank for average total production as shown by Table XI. To bring out more closely the variations in production each month between the trees of the different strains the data were rearranged as shown in figure 13. Each graph represents the proportions of fruit produced during a month by the trees of the various strains, which are presented in each month in the same order from left to right as in figure 12.

The low production in January of fruits of both the Green and Tree-Ripe grades by the trees of all the strains is quite marked, and it is probable that if all conditions had been normal the records would indicate a gradual upward curve at that time instead of the break that is shown. Table IX shows that in 1914 and 1916 the time between the November and December pickings was longer than usual, which



would tend to increase the yield recorded for December. In those same two seasons the time between the December and January pickings was less than the normal period, resulting in a small recorded crop in January. Table XIV shows that a  $2\frac{8}{32}$ -inch ring was used in picking the fruit in December, 1914, and for several months previous, but in January, 1915, a change was made to a  $2\frac{11}{32}$ -inch ring. This in itself would decrease the picking for that month more than half what it would normally be if a ring of the same size as in the preceding month had been used. The variations in the intervals between the picking period in succeeding months and the changes in the size of the ring used tend to make the data of monthly production within the strains somewhat variable, but these variations do not affect the comparative studies between the various strains. It was the custom in the orchard where this plat was located to "clean up" all fruit of the Tree-Ripe grade on the trees in December and May, and the same practice was followed on the study plat, as is shown by the data for those months.

It will be seen that there is considerable variation between

the trees of some of the different strains in the period of their heaviest production. The trees of the Eureka, Dense-Productive, and Small-Open strains bear the largest proportions of their Green-grade fruit from February to May, inclusive, while the trees of the Pear-Shape, Shade-Tree, and Dense-Unproductive strains have their Green-grade fruit more evenly distributed throughout the year, with their maximum production from August to December, inclusive. If the fruit produced by the trees of the latter group of strains was desirable in texture and quality, their increase in production in August and September would tend to increase their value. As a matter of fact, this fruit is not only undesirable but the total production of the trees of

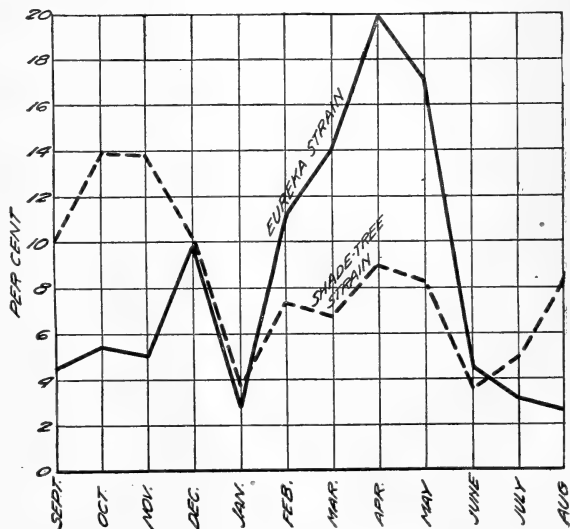


FIG. 14.—Diagram showing the percentages of the total annual crop of fruits of the Green grade produced each month by the trees of the Eureka and Shade-Tree strains of lemons in the investigational performance-record plat during the 3-year period from July, 1914, to June, 1917, inclusive.

these strains is so low as to make them expensive boarders for the grower.

This difference in time of production between the trees of two of the most important strains is very clearly shown in figure 14. This diagram indicates the relative percentage of the total yield of fruit of the Green grade that was produced each month by the trees of the Eureka and Shade-Tree strains, showing the large proportion of fruit borne by the trees of the Eureka strain from February to May, inclusive. During that period the trees of the Shade-Tree strain were yielding a relatively small proportion of their crop, the time of their heaviest production being from September to December, inclusive.

Additional data regarding the season of production is given in Table XV, which shows the production from the entire study plat at each picking during the 3-year period from July, 1914, to June, 1917, inclusive. This is the record of the number of field boxes of fruit produced each month, including the culls. Stated in this concise form, the normal variations in yield from month to month are clearly shown. A study of the second half of the table shows that there are variations in the season of production in succeeding years. These differences are probably due partly to varying climatic conditions in the different years, partly to unavoidable changes in the intervals between the pickings, partly to changes in the size of the ring used for picking the fruit of the Green grade, and partly to variations in the plan for picking the fruit of the Tree-Ripe grade.

TABLE XV.—*Fruit yields of the lemon trees of the Eureka variety in the investigational performance-record plat for each month during the 3-year period from July, 1914, to June, 1917, inclusive.*

[The yields are expressed in terms of the number of field boxes of fruit, including the culls.]

Month.	Total production (field boxes).				Monthly percentage.			
	1914-15	1915-16	1916-17	3-year total.	1914-15	1915-16	1916-17	3-year average.
July.....	18	25	14	57	2.40	3.43	2.93	2.91
August.....	5½	39	9	53½	0.73	5.35	1.88	2.73
September.....	16½	50½	10	77	2.20	6.93	2.09	3.93
October.....	19½	56½	19½	95½	2.60	7.76	4.08	4.88
November.....	43½	44½	26½	114½	5.79	6.07	5.55	5.84
December.....	92	69	53½	214½	12.25	9.47	11.20	10.96
January.....	13½	32	18	63½	1.83	4.39	3.77	3.26
February.....	112	50½	.....	a 200½	14.91	6.93	.....	a 10.26
March.....	95	84	76½	217½	12.65	11.53	16.02	11.10
April.....	147	97½	123½	368½	19.57	13.42	25.86	18.81
May.....	126½	143	109	378½	16.84	19.63	22.83	19.34
June.....	62	37	18	117	8.25	5.08	3.77	5.98
Total.....	751½	728½	477½	1,957½	.....	.....	.....	.....
Heaviest.....	April.	May.	April.	May.	.....	.....	.....	.....
Lightest.....	August.	July.	August.	August.	.....	.....	.....	.....

a February is credited with half of the production for March in 1917.

In order to show in a more striking manner the variations in fruit production by trees of the different strains, Table XVI has been prepared. This presents the calculated yields per acre of fruit of the

Green and Tree-Ripe grades from the trees of the various strains, on the basis of their production for the 3-year period from July, 1914, to June, 1917, inclusive, as shown in Table XIII. This indicates an average total commercial crop of 224 packed boxes per acre by the trees of the Eureka strain, and a yield of only 89 boxes per acre by the trees of the Dense-Unproductive strain. The 10 highest producing trees in the plat bore at the rate of 314 boxes per acre, while the 10 lowest producing trees would have borne only 84½ boxes on the acre basis. The average of the 10 highest producing trees was 60 per cent more than the average of the entire plat, and the average of the 10 lowest producing trees was only 34 per cent of the average of the plat as a whole, or 27 per cent of the amount produced by the 10 highest producing trees.

TABLE XVI.—*Annual yields and calculated production per acre of fruit of the Green and Tree-Ripe grades picked from the lemon trees of the various strains of the Eureka variety in the investigational performance-record plat for the 3-year period from July, 1914, to June, 1917, inclusive.*

Number of trees.	Description of trees.	Average annual production, 3-year period.					Percentage of average of plat.
		Production per tree (pounds).		Calculated production per acre (packed boxes).			
		Green grade.	Tree-Ripe grade.	Green grade.	Tree-Ripe grade.	Total.	
10	Highest producing (all Eureka strain).....	272.26	95.05	232.93	81.32	314.25	160.36
76	Eureka strain.....	180.11	81.99	154.09	70.10	224.19	114.41
2	Dense-Productive strain.....	231.10	65.91	197.72	56.39	254.11	129.67
117	Entire plat.....	162.62	66.43	139.13	56.83	195.96	94.96
10	Small-Open strain.....	153.79	63.70	131.53	54.50	186.08	91.96
2	Pear-Shape strain.....	103.58	75.67	88.62	64.74	153.36	78.26
17	Shade-Tree strain.....	134.81	24.85	115.34	21.26	136.60	69.71
10	Dense-Unproductive strain.....	83.69	20.19	71.60	17.27	88.87	45.35
10	Lowest producing (irrespective of strain).....	1.56	17.31	69.78	14.81	84.59	43.17

Inasmuch as it is the practice in picking lemons to go over the trees at regular intervals, picking each time all fruit that is above a specified diameter, it is interesting to determine what differences there may be in the average weight of the fruits produced by the trees of the different strains. Because of the definite rules governing the time of picking and the size of the fruit picked, whatever differences are found between any of the strains are probably due to variations in (1) the rapidity of growth of the fruit, (2) the physical composition of the fruit, or (3) the shape of the fruit. The rapidity of growth of the fruit is influenced by the vegetative character of the trees and by the quantity of fruit produced. Thick-skinned fruits are lighter than thin-skinned ones of the same diameter. Short, rounded fruits are usually lighter than fruits of the same cross diameter which are longer, unless the increased length is largely made up of thickened peel

Table XVII gives the average weight per fruit of lemons of the Green and Tree-Ripe grades produced by the trees of the various strains of the Eureka variety during the 6-year period. The data for the two grades combined is shown graphically in figure 15. Many of

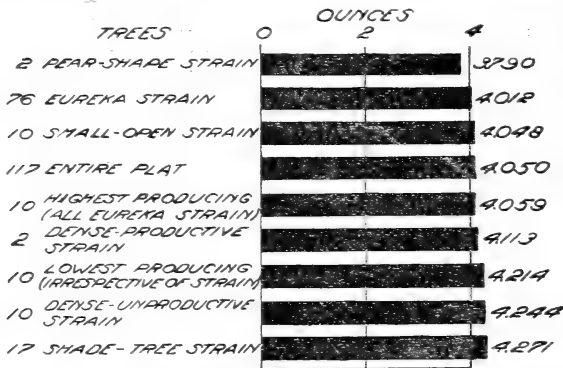


FIG. 15.—Diagram showing the average weight per fruit of the Green and Tree-Ripe grades from the trees of the various strains of Eureka lemons occurring in the investigational performance-record plat for the 6-year period from July, 1911, to June, 1917, inclusive.

the fruits of the Tree-Ripe grade are picked before they reach the size at which the Green-grade fruits are picked; hence, their average weight is less than that of the Green-grade fruits. Throughout the progress of these studies the fruits of the Pear-Shape strain have been recognized as decidedly

slow growing, especially in view of the light production of the trees of that strain. The trees of the Dense-Unproductive and the Shade-Tree strains are not only low producers, but are also very vigorous growing, and their fruits are shown to be above the average of the other strains in weight, as would be expected.

TABLE XVII.—Average weight per fruit for lemons of the Green and Tree-Ripe grades produced by the trees of the various strains of the Eureka variety in the investigational performance-record plat during the 6-year period from July, 1911, to June, 1917, inclusive.

Number of trees.	Description of trees.	Average weight per fruit (ounces).		
		Green grade.	Tree-Ripe grade.	Both grades.
2	Pear-Shape strain.....	4.270	3.194	3.790
76	Eureka strain.....	4.273	3.476	4.012
10	Small-Open strain.....	4.275	3.513	4.048
117	Entire plat.....	4.295	3.483	4.050
10	Highest producing (all Eureka strain).....	4.280	3.490	4.059
2	Dense-Productive strain.....	4.318	3.470	4.113
10	Lowest producing (irrespective of strain).....	4.377	3.546	4.214
10	Dense-Unproductive strain.....	4.411	3.575	4.244
17	Shade-Tree strain.....	4.391	3.624	4.271

Figure 16 illustrates graphically the variations in the average seed content of the fruits from the lemon trees of the different strains of the Eureka variety in the investigational plat. It is shown that the fruits of the Eureka strain contain on the average 7.1 seeds per fruit, which is more than was found in the fruits of any other strain. The fruits from the undesirable Shade-Tree and Dense-Unproductive

strains are more nearly seedless than any of the others, containing 1.84 and 2.26 seeds per fruit, respectively.

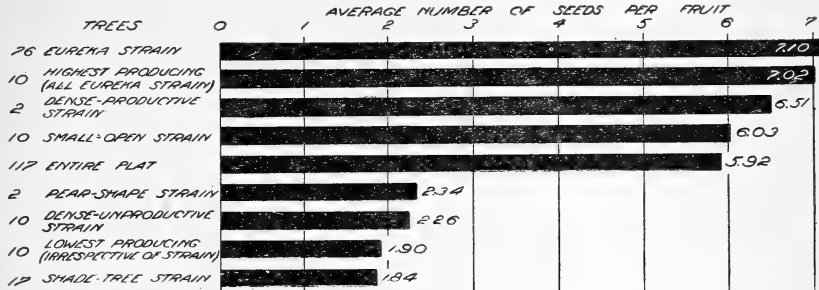


FIG. 16.—Diagram showing the average number of seeds per fruit on trees of the various strains of Eureka lemons in the investigational performance-record plat, during the 5-year period from July, 1911, to June, 1916, inclusive.

In conducting the studies of the seed content of the fruits it was very noticeable that there was a considerable variation in different months of the year. In order to show this seasonal variation, Table XVIII has been prepared, presenting the average number of seeds

found in fruits of the various strains during each month. This table shows a fairly uniform regularity of variation during the different months for the several strains listed, the time of low seed content coming in October, November, and December, with a rapid increase from that time till April, May, and June. Figure 17 shows this variation graphically for the four strains that were most frequent in the performance-record plat. The other strains and groups shown in Table XVIII conform so closely with the

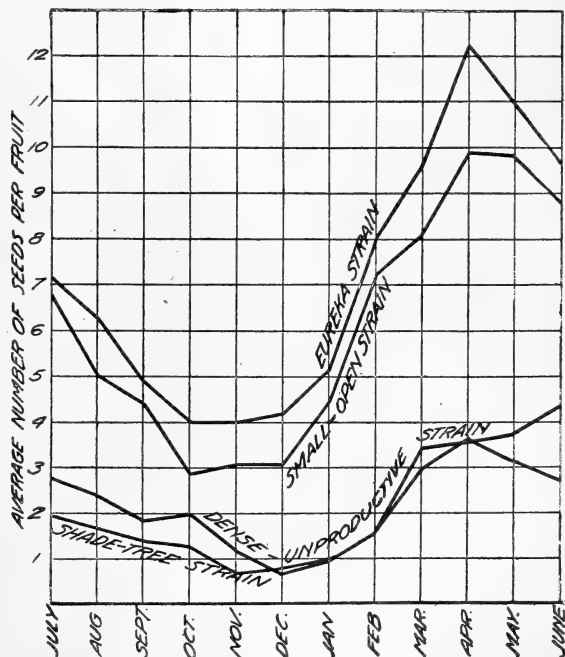


FIG. 17.—Diagram showing the average number of seeds per fruit found each month on trees of some of the most important strains of the Eureka lemon in the investigational performance-record plat, during the 5-year period from July, 1911, to June, 1916, inclusive.

curves shown in figure 17 that it was impracticable to represent all of them clearly in this diagram. A comparison of figures 16 and 17

shows that with the trees of the Eureka, Small-Open, and Dense-Productive strains the period of highest seed content corresponds in general with the time of the heaviest production of fruit.

TABLE XVIII.—Average number of seeds per fruit picked from lemon trees of the various strains of the Eureka variety in the investigational performance-record plat during each month of the 5-year period from July, 1911, to June, 1916, inclusive.

Number of trees.	Description of trees.	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	For the period.
76	Eureka strain.....	7.13	6.27	4.83	4.00	3.99	4.18	5.13	8.06	9.62	12.23	10.92	9.67	7.10
10	Highest producing (all Eureka strain).....	6.87	6.36	5.20	3.50	3.54	4.46	6.04	8.93	9.29	11.85	10.63	8.46	7.02
2	Dense-Productive strain.....	5.25	6.69	6.59	3.00	2.22	3.69	4.33	7.50	8.42	10.52	11.80	9.20	6.51
10	Small-Open strain.....	6.75	5.00	4.39	2.86	3.08	3.07	4.49	7.22	8.07	9.90	9.81	8.80	6.03
117	Entire plat.....	6.18	5.32	4.16	3.33	3.14	3.29	4.15	6.64	8.15	10.29	9.11	8.30	5.92
2	Pear-Shape strain.....	3.00	3.60	1.13	1.60	.57	1.18	1.21	3.05	2.25	4.06	3.95	3.72	2.34
10	Dense-Unproductive strain.....	2.75	2.38	1.82	1.97	1.17	.68	.95	1.58	3.46	3.57	3.78	4.38	2.26
10	Lowest producing (irrespective of strain).....	2.38	1.92	1.52	2.01	.94	.53	.94	1.26	2.66	2.41	3.41	3.65	1.90
17	Shade-Tree strain.....	1.93	1.67	1.40	1.28	.69	.78	.99	1.57	3.00	3.65	3.16	2.76	1.84

#### COMPARATIVE VALUE OF THE STRAINS.

The individual-tree performance-record studies of the Eureka lemon strains, and observations of typical trees of these strains in many orchards in different citrus districts have led to certain conclusions as to the comparative value of the different strains for commercial lemon production in California under existing cultural and marketing conditions.

In the Eureka variety only the Eureka, or Productive, strain has given satisfactory production from all standpoints. Its tendency to produce fruits throughout all seasons of the year is a valuable one. This characteristic of continual bearing has been the main reason for the planting of the Eureka variety by citrus growers in many districts.

The fruits of the Eureka strain are of desirable shape for making a satisfactory commercial package. The juice has a high percentage of acidity and is of superior quality. The fruits, after curing, develop a smooth texture of rind, have a light yellowish or strawlike color, giving them a waxlike appearance, and remain solid and firm when handled in the market.

The Variegated strain is of some value in a very limited way, particularly for ornamental purposes. The striking appearance of the striped leaves and fruits has led many persons living in the citrus districts of California to grow one or more of the Variegated trees in their home grounds. The fruits, while of little commercial value, are of fair quality for home use.

The other strains of the Eureka variety studied in these investigations are of little or no commercial value. Some of them, such as the Shade-Tree, the Pear-Shape, and the Sporting strains are actually

very detrimental to the reputation of the California lemon industry, from the fact that the fruits from the trees of these strains are of inferior quality and when placed on the market are likely to be the cause of serious disappointment to the consumers. The Eureka strain is the only strain in this variety which is of commercial value.

#### THE UNINTENTIONAL PROPAGATION OF UNDESIRABLE STRAINS.

The originators and early propagators of lemon varieties in California have usually used the fruit characteristics as a measure of the comparative value of the parent trees for propagation. Later, the men

who secured commercial bud wood from orchards of the established varieties lost sight of the importance of the fruits in the selection of parent trees as sources of bud wood. In most cases they secured bud wood from the trees where it was easiest to get it—that is, from vigorous-growing trees of the vegetative strains. These strains are usually the least productive and the least desirable. Other propagators assumed that the size of the tree was correlated with production; therefore they secured their bud wood from the largest trees. In other cases nurserymen assumed that they could grow the best nursery stock—that is, the largest



FIG. 18.—Fruit-bearing bud wood on a lemon tree of the Eureka strain, with typical fruits attached. The leaves have been removed from one bud stick in order to show the method of preparing the bud sticks for use.

nursery trees, in a given time from sucker bud wood secured from the largest parent trees. The result of these various practices has been the unintentional propagation of poor fruiting strains. It is believed that the most frequent and important cause of the propaga-

tion of the undesirable strains has been the natural tendency of the bud cutters to secure bud wood from the trees producing the most suckers. In other words, they cut their bud wood from the trees where they could most easily and quickly secure the largest supplies.

The method of using fruit-bearing bud wood for the propagation of the citrus varieties, as shown in figure 18, has been evolved in the course of these investigations and has largely eliminated the danger of the unintentional propagation of the vegetative strains of the Eureka lemon. The use of fruit-bearing bud wood naturally results in bud cutters securing most of their bud wood from the most heavily fruited trees, because more fruit wood is available on such trees than on trees of the poor fruiting strains. When performance records are used as a basis for parent-tree selection and only that bud wood used for propagation which bears typical fruits, the danger of propagating the undesirable strains is largely eliminated.

#### THE ISOLATION OF STRAINS THROUGH BUD SELECTION.

The orchards of the Eureka lemon variety in California are made up of trees of many diverse strains which have originated from bud variations. The description and characteristics of some of the important strains have been presented herewith. It is obvious from these data and observations of the behavior of the trees of the different strains that some of them are not worthy of propagation, because of low and inferior production. Other strains mature their fruit during poor marketing seasons when the prices for lemons are usually low. The trees of some of the strains produce fruits low in acidity, of undesirable shapes for packing, of coarse ugly texture, with little or no juice, or with some other undesirable characteristics. It has been proved that a mixture of strains in orchards is very undesirable and is likely to make the maintenance of such orchards unprofitable.

After determining the relative value of the different strains for commercial production in California, the next step in these investigations was the attempt to isolate each of the important strains through bud selection. This study was made by propagating from typical trees of each strain, selecting the bud wood on the basis of tree-performance records and intimate tree knowledge. Only fruit-bearing bud wood was used for this purpose, with typical fruits of the strain attached to each bud stick.

The first trees grown from these propagations are now 4 years old from planting. Individual-tree performance records are being secured from some of these progenies. While the performance-record data obtained in the course of this work are incomplete as yet, there is sufficient evidence in hand to warrant the statement that each of the important lemon strains has been isolated through bud selection. This means that the strain characteristics in the progenies



of the typical parent trees have been uniformly transmitted. Variations in some of the individual trees in these progenies, similar in degree to those of the parent trees, have been found. However, no mixture of strains has been discovered so far in the progenies. Therefore, it can be safely stated at this time that it is practicable to isolate the different strains through bud selection based upon individual-tree performance records and intimate tree knowledge.

#### TOP-WORKING UNDESIRABLE TREES.

The healthy unproductive lemon trees of undesirable strains in bearing orchards can usually be successfully top-worked through the use of bud wood selected from desirable and superior performance-record trees. Figure 18 shows two such bud sticks before they have been cut from the parent tree. Three bud sticks cut from the tree and ready for use are illustrated in figure 19.

The top-working is usually best done during the months of April, May, and June. As a rule, in the instances under observation, the best results have been obtained during May and early June. Fall top-working is not usually done on account of possible frost damage to the tender growth, except that it is the practice of some growers to insert buds in the trees to be top-worked during the late fall and allow the buds to remain dormant until spring. The advantage claimed for this method is that if any of the buds do not unite with the limbs in which they have been inserted and die during the winter new buds can be used in the spring, resulting in a more uniform stand than with spring budding. Observations during the course of these investigations do not bear out this contention, so that spring budding is strongly recommended for top-working.

The trees selected for top-working should be so pruned as to allow free access to the limbs in which the buds are to be inserted, as shown in figure 20. The limbs for top-working should be selected from the standpoint of furnishing a strong and suitable framework for the new tops. Usually from three to five such foundation limbs are necessary for the best results. The best place for the insertion of



FIG. 19.—Typical fruit-bearing bud sticks from a lemon tree of the Eureka strain. The bud sticks after being cut and trimmed should be packed in slightly moistened sphagnum moss and held in a cool room until needed for use. (One-half natural size.)

the buds on the limbs is usually from 1 to 2 feet from the fork of the branches. The best results are usually obtained by using two buds for each limb and inserting them near the under side of the limb.

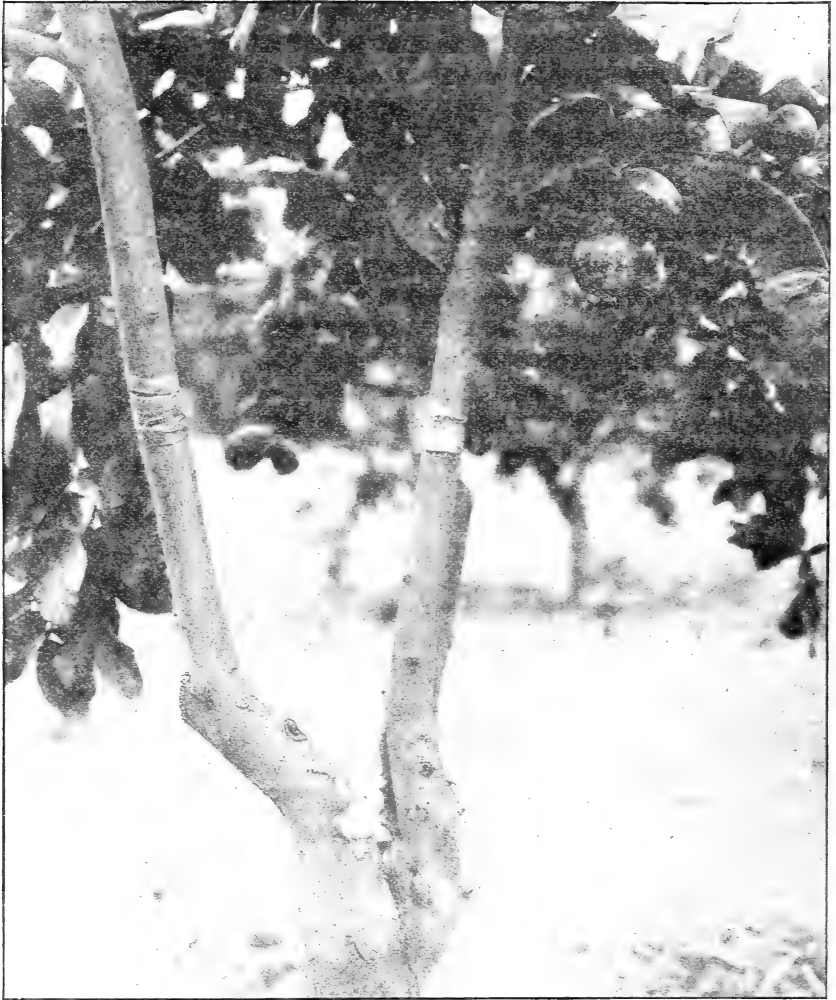


FIG. 20.—An undesirable lemon tree of the Eureka variety rebudded with select buds from fruit-bearing wood, showing the pruning of the tree preparatory to budding, position of the buds, and method of wrapping the buds with strips of waxed cloth.

At least one of the two buds on each limb is likely to develop, so that a perfect stand can usually be secured in this manner. With old trees having a thick bark the space where the buds are to be inserted should be thinned down with a sharp knife. In the case of older trees having very heavy bark the bark should not only be thinned down but a small section of it should be removed where the bud is exposed. This precaution frequently prevents the thick bark from growing over the inserted bud and killing it.

In from 10 days to 2 weeks after the buds have been inserted they will have united with the limbs, and the wounds in the limbs will have healed. At this time the limbs in which the buds have been placed should be cut off about 6 inches above the buds and all other limbs removed from the trees. In some instances one limb, in addition to those which were budded, is allowed to remain for a year after budding, in order to preserve somewhat the balance of the tree and to act as a nurse limb, so to speak, for the budded limbs.



FIG. 21.—A typical lemon tree of the Shade-Tree strain of the Eureka variety, top-worked with fruit-bearing bud wood from a tree of the Eureka strain in June, 1911. The original unproductive top has been replaced with a productive one bearing fruit of the finest quality. The freeze of January, 1913, severely injured this tree and retarded its development. Photographed in February, 1915.

When the limbs have been cut off, the cut surfaces should be covered immediately with grafting wax, asphaltum, or other protective material. The trunk and parts of the limbs left after cutting should be thoroughly coated with whitewash, in order to protect them from injuries due to sunburn. After a year the stubs of the rebudded limbs should be cut back again, making a smooth sloping cut and leaving only one sprout from one bud on each limb. The cut surfaces should again be covered immediately with some protective material.

For two or three years after top-working, great care must be used in order to remove all growth other than that from the buds inserted in the limbs, otherwise the new top is likely to be made up partly of sprouts from the trunk and limbs instead of wholly from the selected buds, and the object of top-working be thereby defeated. Under normal conditions the growth from the selected buds in the top-worked trees will begin bearing lemons in the second year and during the third and fourth years will produce profitable crops (fig. 21).

#### REPLACING UNDESIRABLE TREES IN BEARING ORCHARDS.

In some instances it is desirable to remove the unproductive, unhealthy, or otherwise undesirable trees in full-bearing orchards and replant with reliable trees grown from selected buds rather than to top-work them. Until recently such replanting has frequently been unsuccessful. Experience has shown, however, that such undesirable trees can be removed and reliable trees substituted for them, when careful attention is given to a few fundamental requirements in providing the proper conditions for the young trees.

The trees selected to be taken out should be removed during the late summer or early fall. Excavations should be made for the new trees immediately after the older trees have been taken out. In this work holes should be dug about 5 feet in diameter and from 2 to 3 feet in depth. The holes should be filled with good topsoil, mixed, if possible, with well-rotted manure. They should be left in this condition during the winter and early spring so that the loose soil and manure in the holes will settle into position. The holes should be filled so that after settling the filling will stand at least 6 or 8 inches above the level of the land in the orchard. In this way any future settling will be provided for, and the new trees will eventually stand in the same position with reference to the surface of the land as the remainder of the trees in the orchard.

In the spring when the young trees are planted in the places provided for them, care must be taken to see that they are given sufficient water during each irrigation. This is usually best done by making a special irrigation furrow alongside or around each tree. It is also advisable to give the replanted trees small applications of some quickly available nitrogenous fertilizer, in order to stimulate early growth.

With large, well-prepared planting holes, adequate irrigation, and additional fertilization, the replanted trees will grow in bearing orchards about as well as though planted alone. Sometimes it is advisable, particularly in the case of close plantings, to dig trenches midway between the bearing trees and the replanted ones and fill them with manure. This precaution will enable the young trees to establish themselves without competition with the roots from the older trees.

## THE SELECTION AND CARE OF BUD WOOD.

Bud wood should be taken only from trees whose behavior has been recorded by means of performance records. The selection of the parent trees should be based not only upon their performance records but also upon intimate tree knowledge developed from careful observation

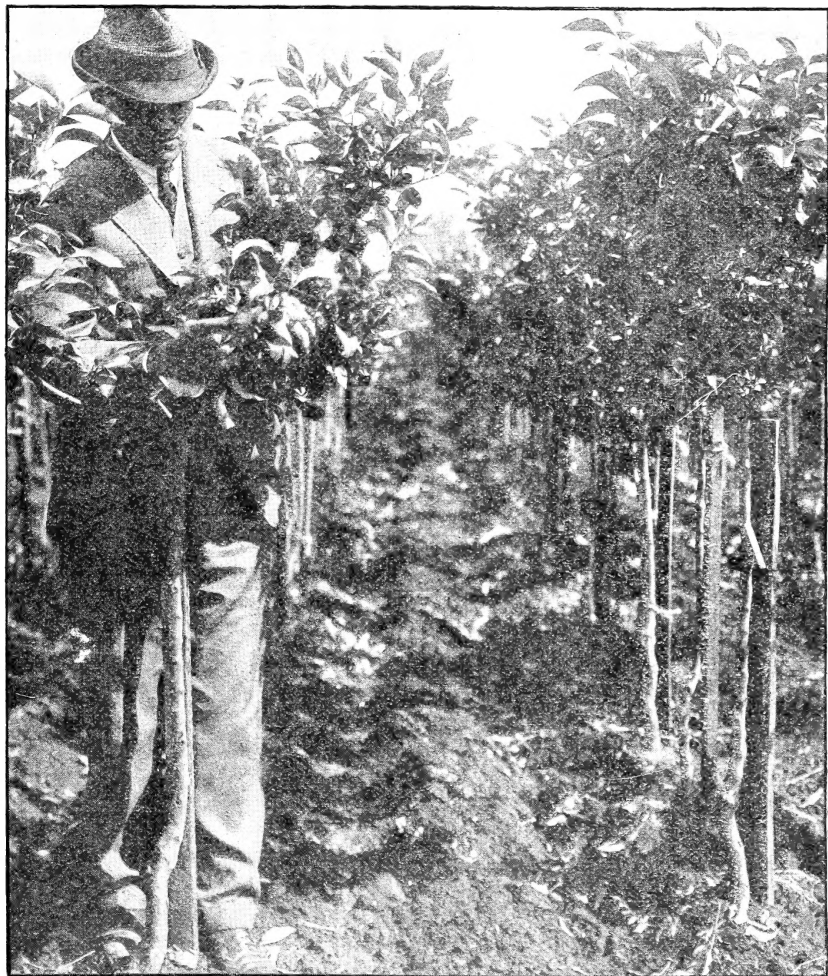


FIG. 22.—Nursery trees grown from fruit-bearing lemon bud wood of the Eureka strain, two years after budding, showing the vigorous growth and early fruiting tendency of trees propagated from such buds.

and experience with the variety, the strain, and the individual trees. Fruit-bearing bud wood should be taken only from superior trees. The buds from this immature bud wood make as satisfactory growth as those taken from larger growth or more mature wood. The lemons attached to each bud stick indicate the type of fruit propagated and insure so far as possible against the use of buds from sporting or un-

desirable branches. More buds can be cut from productive trees if this method is followed than from unproductive ones. Sufficient evidence, both experimental and practical, has been obtained to warrant the statement that fruit-bearing bud wood from productive trees is the most desirable kind to be used for propagation. The vigorous growth and early-fruited tendency of nursery trees grown from such bud wood are illustrated in figure 22.

After the bud sticks have been cut the leaves and fruits should be clipped off, as shown in figure 19, and the bud sticks from each tree tied in a separate bundle with the number of the tree marked on one of the bud sticks or on a suitable label tied to the bundle. In this way the progeny of each tree can be kept separate if desired.

As soon as the bundle of bud sticks is obtained it should be wrapped in some moist material, commercial sphagnum moss being suitable for this purpose. In moistening the dry moss, either of two methods may be followed. The moss can be moistened safely by adding about half an ounce of water to each ounce of dry moss, or it may be steamed or soaked in water, after which it should be run through a clothes wringer so adjusted as to bring the greatest possible pressure to bear on the moss.

If the bud sticks are to be kept for some time before being used they should be stored where the temperature is about 70° F. and does not fluctuate greatly at any time. Under these conditions the bud wood may be kept in good condition for several weeks.

In May, 1917, the California Fruit Growers' Exchange, a cooperative organization of about 8,000 citrus growers, established a bud-selection department as a result of these investigations. The purpose in the organization of this department is to provide adequate and reliable sources of bud wood of citrus varieties, including lemons, for use by all growers and propagators. As this department was established as a matter of public service and for the benefit of the citrus industry as a whole, the buds are distributed at cost to those who apply for them, whether the applicants are members of the exchange or not. The buds are taken only from trees selected on the basis of their performance records for several successive seasons. The orchards for this purpose are selected for their known production of superior crops of valuable fruits.

In obtaining commercial supplies of reliable bud wood from the superior individual trees of the best strains in the orchards finally selected for this purpose, the purchaser has the opportunity of visiting and studying the trees from which bud wood is to be cut, inspecting the records of the individual trees, and examining the fruits produced by them.

In cutting the bud wood from the carefully selected trees only fruit-bearing wood is chosen. The fruits from the bud sticks are returned to the owner of the trees. Each lot of bud sticks from each tree is

tioned in a bundle and the number of the parent tree or a key number is attached to it. In this way the propagator, if he so desires, can keep the progeny of each parent tree separate.

The bud sticks are cut only by men trained in this work, so as to avoid the danger of cutting bud wood from variable branches and to insure against mistakes in choosing the bud wood. The bundles of bud sticks are packed in properly moistened, sterile, sphagnum moss and delivered to the propagators as soon as practicable, in order to avoid possible injuries from storage. In this way trees of the best lemon strains are being propagated, so that the production from orchards planted with these trees can reasonably be expected to be uniformly of the best type and quality, thus insuring the best possible economic results to both the producers and the consumers.

#### SUMMARY.

The important commercial lemon varieties now grown in California are the Eureka, Lisbon, and Villa Franca. The Eureka variety originated from a seedling in the city of Los Angeles about 1860.

Several important strains of each of the varieties have arisen through the unintentional propagation of bud variations. In this bulletin only the variations within the Eureka variety are discussed. Descriptions of variations in the Lisbon lemon will be found in United States Department of Agriculture Bulletin No. 815.

Bud variations are of frequent occurrence in some of the trees of the Eureka variety. They are of great importance to the lemon industry in that some of the strains which have developed from them are inferior in quantity and quality of production. Bud variations are much more common in lemon varieties than has heretofore been thought to be the case. They occur as variations in the habit of tree growth, in the characteristics of foliage and blossoms, and in the color, shape, size, texture, juiciness, and other characteristics of the fruits.

The object of these investigations has been to determine the behavior of the trees of the different strains and of the individual trees within the strains, to develop practicable methods for eliminating undesirable trees in established orchards, to prevent the propagation of inferior strains, and to isolate and propagate the superior ones through bud selection based on individual-tree performance records and on intimate tree knowledge.

The plan of work in these investigations has been to secure individual-tree performance records in carefully selected plats of the Eureka variety where the conditions are most favorable for obtaining reliable and comparable data.



The method of keeping the individual-tree performance records is to pick each tree separately, assort the fruits, count and weigh them; make descriptive notes, photographs, and drawings of the trees, foliage, and fruits; and record these data so that after an adequate number of studies have been made conclusions as to varietal, strain, and tree behavior can be safely drawn.

In these investigations eight strains of the Eureka lemon have been studied, their characteristics described, and the performance of typical individual trees recorded.

Some of the lessons taught by these studies include the discovery of the importance of bud variations and the comparative value of the different strains arising from them, the necessity for and methods of isolating the valuable strains and eliminating the unprofitable ones through bud selection, the determination of the characteristics of the trees, flowers, and fruits of the different strains, and the origination and introduction of improved methods of propagation for conserving and improving the production of the lemon industry.

The desirable strains can be isolated through bud selection based on tree-performance records and intimate tree knowledge.

Undesirable healthy trees in established orchards can usually be successfully top-worked by the use of carefully selected buds.

The undesirable unhealthy trees can be replaced in established orchards through replanting with desirable ones when proper attention is given to the preparation of the planting holes and adequate care in irrigation and fertilization is given to the individual trees.

Only fruit-bearing bud wood from superior parent trees selected on the basis of their performance records and intimate tree knowledge should be used for propagation or for top-working.

In California, as a result of these investigations a department of bud selection has been established by the California Fruit Growers' Exchange, a cooperative organization of citrus growers, whereby reliable bud wood from superior performance-record lemon trees can be obtained by all growers and propagators.

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