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NEW CITRUS HYBRIDS

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HYBRIDS OF THE TANGELO GROUP

In the course of breeding new types of citrus fruits numerous reciprocal crosses have been made, most of the varieties commonly grown being utilized as parents as well as some little-known citrus and related species. The more important of these citrus hybrids have been described in short papers from time to time, these descriptions dealing chiefly with the citranges (5, 10),¹ limequats (5, 6, 9, 11), citrangequats (9), and tangelos (5, 7, 8).

The citranges are hybrids of the deciduous trifoliolate oranges (*Poncirus trifoliata* (L.) Raf.), hardy as far north as Washington, D. C., and Philadelphia, Pa., and the common sweet orange (*Citrus sinensis* (L.) Osbeck). The citrange is the hardiest edible citrus fruit; but although often beautiful, the different varieties are very sour, have a bitter aftertaste, and are used only sparingly for "ade." The citranges make excellent stocks for the commonly cultivated citrus fruits and are used chiefly for this purpose.

The limequats are hybrids of the West Indian lime (*Citrus aurantifolia* (Christm.) Swingle) and the kumquat, two species, *Fortunella japonica* (Thunb.) Swingle and *F. margarita* (Lour.) Swingle, being used in these hybrids. The limequats bear fruits much like ordinary limes in size, shape, color, and flavor, but the tree is much hardier than the lime and can be grown in far colder climates, nearly up to the northern limit of citrus culture.

The citrangequats, as the name indicates, are hybrids of the citrange and the kumquat, and they bear small acid fruits somewhat like limes but of inferior quality. The citrangequat tree, however, is much hardier than the West Indian lime or even the limequat, but

¹ Italic numbers in parentheses refer to Literature Cited, p. 18.

is not quite so hardy as the citrange. Some of the citrangequats are being used for stock, to which purpose they seem to be fairly well adapted.

Of all these hybrids, the tangelos have attracted the most favorable attention because they yield a whole new series of orangelike fruits, many of them more beautifully colored than any orange and of exquisite flavor and aroma. But unfortunately they are often too soft to stand up well under long-distance shipment if packed in the usual way.

PREVIOUS TANGELO HYBRIDS

The tangelo, a hybrid between the tangerine (*Citrus nobilis deliciosa* (Ten.) Swingle) and the grapefruit (*C. grandis* (L.) Osbeck), was one of the first of the early crosses to be selected for propagation. Two varieties, the Sampson and the Thornton, have been previously described (5, 7, 14, 15), and trees of these varieties have been obtainable through the nursery trade, especially in Florida, since about 1915. The first crosses giving rise to these new fruits were made in 1897 at Eustis, Fla., by the senior writer, and in 1898 additional crosses were made by H. J. Webber. The severe freeze of 1899 acted as a check on the active development of these and other new hybrids, and it was five years or more before specimen trees yielded fruit for testing. A few small commercial groves in Florida are now planted to tangelos, chiefly of the Sampson variety, but the marketing is mainly confined to a private-order trade with fancy-fruit dealers or with individuals who appreciate the unique piquancy of these new fruits.

As pointed out in previous publications, the Sampson and Thornton varieties are handicapped as commercial fruits by certain characteristics that have restricted their planting. While thrifty in growth and prolific, the fruit needs special care in handling in order to reach the market in salable condition. The modern packing house subjects citrus fruits to a rather involved process of cleaning and polishing before they are graded, sized, and packed; therefore a good shipping fruit must have a fairly tough rind and solid flesh. The Sampson tangelo is so thin skinned that it is easily bruised; moreover, it is very susceptible to sun scald and has a tendency, especially when grown on rough lemon stock, toward the drying out of one or more segments, often confused with sun scald. This variety is also very susceptible to citrus scab (16, 17); consequently it is difficult in some seasons to produce even a fair percentage of unblemished fruit. It turns yellow months before it is ripe, and colors to an attractive deep-orange tint several weeks before it is fully mature; in consequence it is often picked and shipped when much too acid for consumption. It is not at its best until February or March.

The juice of the Sampson tangelo has such a characteristic "tang" that it is in growing demand for making "tangelo-ade." In preparing this "ade" it is not necessary to use all tangelo juice, because the juice imparts a distinctive quality if added in the proportion of 25 per cent, or even less, to orange or grapefruit juice or to a mixture of these juices. This use of tangelo juice has afforded a profitable outlet for second-grade fruit and has helped to encourage the planting of this variety, especially in Dade County, Fla.

The Thornton tangelo matures much earlier than the Sampson, often being sweet and delicious in December, although holding well into March or even later. In appearance it is somewhat coarse, with a roughened or pebbly rind; but its chief handicap is that when ripe it becomes so soft and puffy that it suffers injury when subjected to the regular packing-house treatment, and it therefore needs hand grading and packing to stand long-distance shipment. Notwithstanding these handicaps, both varieties have enthusiastic adherents, and both will doubtless continue in cultivation, on a limited scale at least.²

Like many of the citrus hybrids, the Sampson tangelo comes true from seed with striking regularity. Hundreds of seedlings have been grown without revealing vegetative diversity, and in a group of 42 seedlings brought to fruiting at Little River, Fla., all showed remarkable adherence to type in growth and fruit characteristics. This uniformity is due to the fact that this hybrid is sterile in the sense that the seed is developed from the tissues of the mother plant, and consequently reproduces the variety without change (6).

In vegetative propagation the Sampson, as well as most other tangelo varieties, differs from the parental fruits. Cuttings of the tangerine and the grapefruit may be rooted, but with considerable difficulty, only a small percentage striking root even when given favorable conditions. Leafy twig cuttings of the tangelo, however, may be rooted without difficulty and with only moderate loss if care is taken to maintain proper conditions of humidity and temperature, such as is afforded by a humid greenhouse chamber with bottom heat or by the solar propagation frame especially devised by the writers for the propagation of citrus cuttings (12). The greater readiness with which citrus hybrids may be rooted from cuttings as compared with the parental varieties has been already noted in the case of the Thomasville citrangequat (9).

As the publications in which the original tangelos (Sampson and Thornton) were first described have been out of print for a long time, a description of these varieties in the light of recent experience is here given.

SAMPSON TANGELO

(C. P. B.³ 1316; pl. 1)

Technical description.—Fruit the size of a medium-large orange, slightly flattened at blossom end with characteristic raised nipple at stem end, 2¾ to 3 inches in diameter; color, orange yellow (Ridgway,⁴ orange buff to capucine yellow); rind very thin, smooth, and glossy, fairly free peeling when the fruit is fully mature, but not kid glove in character; oil cells numerous, conspicuous, translucent, practically flush with surface; segments 9 to 11, separating easily, membranes thin and tender, small amount of rag, small open core; pulp tender,

² Through the cooperation of the Bureau of Chemistry and Soils of the U. S. Department of Agriculture, tests of the tangelos (Sampson and Thornton varieties) as sources of vitamin B were made in 1928. In these tests the tangelo was compared with the parental fruits, tangerine and grapefruit. Charts showing the weight curves of rats fed the designated fruits as a source of vitamin B were prepared but as yet are unpublished. The following summary may be given at this time, with the approval of Breese Jones and E. M. Nelson, who carried out these vitamin tests: Both charts are in agreement in showing tangerine juice to be a better source of vitamin B than the juice of the other fruits fed, and also in that tangelo juice is approximately equal in vitamin B potency to grapefruit juice. Therefore, with respect to vitamin B production the tangelo has inherited the characteristics of the grapefruit.

³ These initials refer to the former Office of Crop Physiology and Breeding.
⁴ RIDGWAY, R. COLOR STANDARDS AND COLOR NOMENCLATURE. 43 p., illus. Washington, D. C. 1912.

extremely juicy, with characteristic aroma, a sprightly and characteristic blending of sweetness and acidity when fully ripe; color of pulp salmon-orange (Ridgway, light salmon orange to salmon orange), unique among citrus fruits; seeds fairly numerous, 15 to 20, of medium size, greenish in cross section like tangerine seed. Tree evergreen, fairly vigorous and productive, about as tender as grapefruit; leaves unifoliate, small to medium size, 2 to 3 inches in length, rounded oval, boat shaped with constriction along the midrib giving a characteristic appearance; petiole narrowly winged or wingless. The season of maturity is February to April.

When grown in the coastal regions of California this tangelo is generally much reduced in size and very acid. It is not commonly grown commercially outside of Florida.

Plate 1 shows the shape and relative size of the Sampson tangelo as compared with two other tangelos, Thornton and Williams.

THORNTON TANGELO

(C. P. B. 1282 ; pl. 1)

The original records of the group of hybrids giving rise to the Thornton tangelo were lost, so that the pollen parent is not definitely known. As many of the sister hybrids show unmistakable tangerine characteristics, however, it is safe to say that this fruit is a tangelo with grapefruit the known seed parent. For some years after it first fruited its original hybrid number was also unknown, but identical fruit under C. P. B. 1282 has been produced for several years at Little River, Mount Dora, and Eustis, Fla., leaving little doubt as to its proper place in the series of hybrids made by the senior writer in 1899.

Technical description.—Fruit the size of a small grapefruit, $2\frac{3}{4}$ to $3\frac{3}{4}$ inches in transverse diameter by $2\frac{7}{8}$ to $3\frac{1}{4}$ inches in height, flattened at blossom end and tapering slightly toward stem end, calyx set in slight depression, having shallow radiating grooves in the rind; color similar to common orange (Ridgway, orange buff to deep chrome); rind soft and thick (three-sixteenths to one-fourth inch), somewhat wrinkled and pebbly, the roughness in part due to deeply indented large and numerous oil cells, free peeling, of kid-glove character and puffy when ripe; segments 10 to 12, separating easily and having considerable adhering membrane or rag, open core with pithy central column; pulp very soft and melting, juicy, translucent, of mild flavor, sweet, somewhat lacking in acidity, especially when fully ripe, slight aroma; color of pulp, pale orange (Ridgway, orange buff to deep chrome); seeds varying from 10 to 25 per fruit, long and slender, resembling orange seeds but greenish in cross section. Tree evergreen, thrifty and productive, about as tender as grapefruit; leaves unifoliate, rather large and long-pointed, resembling common sweet orange rather than either parent.

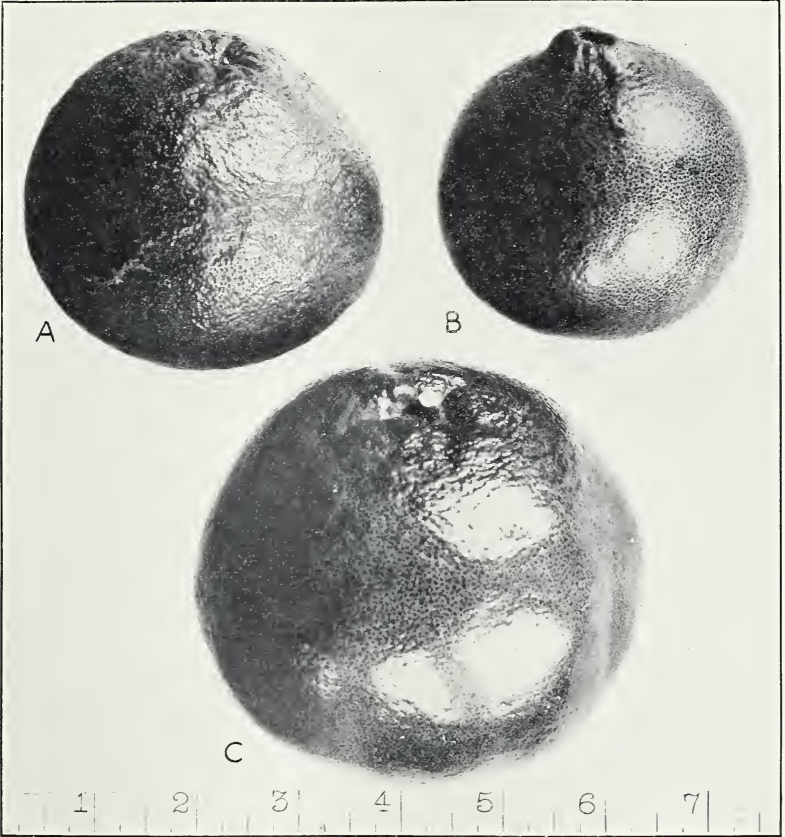
The season of this fruit is from December to March.

The Thornton tangelo grown in the intensely hot, irrigated Coachella Valley at the United States Experiment Date Garden at Indio, Calif., has shown itself to be very well adapted to this severe climate. Although the fruit is smaller than that grown in Florida, it is of excellent quality.

WILLIAMS TANGELO

(C. P. B. 1397 ; pl. 1)

The Sampson tangelo resulted from a cross in which pollen of the Dancy tangerine was used to pollinate an ordinary grapefruit. The grapefruit so cross-pollinated contained a large number of seeds, 76 in all, which gave a total of 106 seedlings (several seeds sending out



Fruits showing relative size, rind texture, and shape of Thornton (A), Sampson (B), and Williams (C) tangelos. (Reduced according to scale shown in inches)

more than one sprout), and these seedlings were serially numbered from 1310 to 1415. With the exception of the Sampson tangelo (C. P. B. 1316), most of the seedlings appeared to be false hybrids or ordinary grapefruit; however, a number of them were distributed to cooperators to be tested for possible hybrid character.

Several seedlings were sent to H. S. Williams, of Rockledge, Fla., about 1900, only one of which proved to be a hybrid (C. P. B. 1397). Thus this fruit is a sister hybrid of the Sampson tangelo (C. P. B. 1316), though of quite different character. However, trees under this number that fruited at Little River and Mount Dora, Fla., produced fruit identical with that of C. P. B. 1397.

No propagation of C. P. B. 1397 appears to have been made at Rockledge, but E. S. Williams, son of H. S. Williams, took bud wood later to Fort Pierce, Fla., where he propagated the variety and set out a grove of several acres. The fruit was found profitable for use in supplying some of the tourist hotels on the east coast and in filling private orders. In the region where grown it is commonly called the Williams tangelo, and that name is herein adopted.

Technical description.—Fruit of the size, shape, and general appearance of grapefruit, though decidedly flattened, deeply depressed at blossom end, with less marked depression surrounding calyx, from which radiate shallow grooves; transverse diameter of fruit $3\frac{3}{4}$ to 4 inches, vertical diameter $2\frac{7}{8}$ to 3 inches; color, grapefruit yellow slightly tinged with orange (Ridgway, cadmium yellow); rind of medium thickness (one-eighth to three-sixteenths inch), fairly free peeling, smooth and glossy, oil cells very small and numerous, slightly indented; segments numerous, 13 to 15, regular, with rather large open core, separating easily like a tangerine; seeds varying from 10 to 15, white in cross section, resembling grapefruit seeds; pulp of melting quality, very tender and juicy, with little rag, of amber color (Ridgway, primuline yellow), flavor mildly subacid and of pleasing quality when ripe, lacking the bitterness of grapefruit but not insipid. Tree evergreen, thrifty and productive, of general habit of grapefruit; leaves unifoliate, resembling rather large orange leaves, petiole wings variable.

The season of this tangelo in Florida is from late January to March, slightly earlier than the Sampson. Its shape and rind character make it a good shipping fruit, though it shows a tendency to dry out if held on the trees past full maturity. In its general resemblance to a small or medium-sized grapefruit it lacks the distinctive character of the other tangelos that have been selected for propagation, but possesses sufficient merit to warrant its inclusion in collections of citrus fruits for the home fruit garden or local markets.

A NEW SERIES OF TANGELOS

A new series of crosses was made in the period from 1908 to 1912 by the senior writer and his assistants, E. M. Savage and the late F. W. Savage, working principally at Eustis and Glen St. Mary, Fla. These cross-pollinations included not only the tangelo group but also a very wide variety of combinations between citrus varieties and species. In the tangelo group it was hoped that the use of different parents and the growing of a much larger number of seedlings from cross-pollinated fruits would lead to securing tangelos of better shipping qualities, less subject to scab, and yet retaining the attractive appearance and peculiar zest of these desirable fruits.

These hopes have been realized in a measure, though further tests on a larger scale will be necessary before final selections can be made.

The excellence of some of these new fruits, however, justifies the publication of descriptions and giving them convenient names for future identification. In making selections one important feature has been kept in mind—to render possible a longer shipping season by securing both extra early and extra late maturing sorts. The selection of a new fruit that meets requirements of this sort may be justified, even though it falls short of the ideal in some other respect. Seedlessness (or few seeds) is likewise a character important enough to receive consideration in appraising the value of a new citrus fruit.

The season of maturity assigned to these new fruits in this circular is based on their behavior at Eustis, Fla., during and prior to the season 1928–29. In the season following, arsenical sprays used in the clean-up campaign for the Mediterranean fruit fly resulted in premature ripening in many instances. The time of maturity may prove to be somewhat earlier or later in other parts of Florida, and doubtless will be influenced by stocks used and culture given. Experiments to evaluate these factors are in progress in several test plantings in Florida.

LAKE TANGELO

(C. P. B. 52018-G-26; pl. 2)

The Lake tangelo is the earliest maturing of the new tangelos. It is the result of a cross in which the Bowen grapefruit was pollinated with pollen from the Dancy tangerine. The fruit matures in time for the Thanksgiving market, although keeping in good condition till two months later. The name Lake has been chosen because of its first fruiting at Eustis, in Lake County, Fla., where it has fruited four seasons.

Technical description.—The fruit is small for a tangelo, the size and shape of a large tangerine, but more nearly resembling a highly colored orange in general appearance. In size the average fruit is 3 inches in transverse diameter by $2\frac{3}{4}$ inches in vertical diameter; of deep orange color (Ridgway, orange chrome), becoming almost tangerine red when fully mature; rind one-eighth inch thick, slightly pebbly though not rough, firm, with characteristic shallow grooves radiating from stem end, calyx slightly depressed, blossom end flattened with slight depression when fully mature; oil cells small, numerous, indented; segments 12 to 14, with 10 to 12 seeds (rather short and plump, closely grouped at center); open core, little rag; pulp of deep-orange color (Ridgway, cadmium orange), tender and melting, very juicy, sweet with rather low acidity but not insipid. Tree evergreen, thrifty in habit, prolific; leaves unifoliate, variable in size, small to medium (3 to 4 inches long), pointed with gently rounded base, petioles rather short, variable, either winged or wingless.

The attractive appearance and early maturity of this fruit especially recommend it for the fancy trade, supplying a need at a time when tangerines are not yet sufficiently mature for shipment. It is not, however, a kid-glove fruit but is more like a highly colored sweet orange in character.

SEMINOLE TANGELO

(C. P. B. 52018-F-23; pl. 3)

The Seminole tangelo ranks next to the Lake in earliness of maturity, ripening in December, about as early as the Thornton, and holding well into March. Like the Lake tangelo, it resulted from



Typical fruits of the Lake tangelo (C. P. B. 52018-G-26)
(About two-thirds natural size)

ERRATA

United States Department of Agriculture Circular 181, New Citrus Hybrids

In the reproduction of Plate 3 the seeds are shown as green with a yellowish cast, whereas in nature and in the original painting they are light yellow with a greenish cast.

The colored plates are from paintings by R. C. Steadman.



Typical fruits of the Seminole tangelo (C. P. B. 52018-F-23)
(Natural size)



Typical fruits of the Minneola tangelo (C. P. B. 52018-Q-4)
(About two-thirds natural size)

pollinating the Bowen grapefruit with pollen of the Dancy tangerine. The fruit is somewhat larger than the Lake tangelo, but smaller than the Thornton or the Sampson; in general appearance it is more like a highly colored orange. The variety is named Seminole from the springs of that name located in Lake County, Fla.

Technical description.—Fruit of average size is $3\frac{1}{4}$ inches in transverse diameter by $2\frac{3}{4}$ inches in vertical diameter, decidedly flattened at blossom end and without the nipple at the stem end characteristic of the Sampson; calyx small and angular, 5-pointed; rind smooth and glossy, of deep reddish orange color (Ridgway, orange chrome), thin but firm (one-eighth to three-sixteenths inch thick), fairly tight but peeling more easily than the common sweet orange; oil cells somewhat translucent; indented, slightly corrugated area surrounding calyx; segments 11 to 13, somewhat irregular in shape and size; seeds fairly numerous, 20 to 25, or even more, but small, short, plump, and closely grouped at center, greenish in cross section; pulp of rich orange color (Ridgway, mikado orange), translucent, tender and melting, little rag, agreeable aroma, and sprightly flavor closely resembling the Sampson tangelo but with less acidity. Tree evergreen, fairly vigorous and productive; leaves unifoliate, rather small and rounded ($1\frac{3}{4}$ inches to $2\frac{1}{2}$ inches long), slightly recurved or boat shaped (resembling Sampson); odor of tangerine well marked in new foliage, petioles narrow, wingless or very narrowly winged.

This is one of the most attractive of the new hybrids, or of citrus fruits generally. The rind character and the shape of the fruit give evidence of good shipping qualities; there is no tendency to sun scald or to dry out, and there seems to be decided resistance to citrus-scab infection, as compared with the Sampson tangelo.

MINNEOLA TANGELO

(C. P. B. 52018-Q; pl. 4)

The Minneola tangelo is of the same parentage as the Lake and Seminole tangelos, but it is still later in maturity, being at its best from February to April. Its high color, good shipping quality, and few seeds especially recommend this new fruit for consideration and trial. It has been given the Seminole Indian name of Minneola (Min-ne-ō'la) after the town of that name in Lake County, Fla.

Technical description.—Fruit the size and shape of a medium-large flattened orange, average fruit $3\frac{1}{4}$ inches in transverse diameter by 3 inches in vertical diameter; calyx small, its area often slightly raised but not forming a distinct nipple (as in the Sampson); color when fully ripe a deep reddish orange (Ridgway, orange chrome to flame scarlet), fairly smooth, slightly roughened by oil-cell indentations; rind thin to medium (one-eighth to three-sixteenths inch), firm, not free peeling; segments 10 to 12, with rather tough segment walls and small open core; seeds comparatively few in number, 7 to 12, small and closely grouped in center, greenish in cross section; pulp of orange color (Ridgway, mikado orange), translucent, tender, melting, very juicy, somewhat aromatic, combining desirable sweetness and acidity, resembling the Sampson tangelo but more mild in flavor. Tree evergreen, vigorous, and productive; leaves unifoliate, rather large, varying from $3\frac{1}{2}$ to 5 inches in length, long pointed, tapering more abruptly at the base, petiole of medium size, narrow to medium size winglets.

The difference in season of this tangelo as compared with the Lake and Seminole, the attractive color, good shipping quality, few-seeded character, and excellent flavor recommend this fruit for consideration and trial. It is moderately susceptible to scab, but does not become nearly so badly disfigured as the Sampson when attacked. It shows no tendency to sun scald or drying out, either on the tree or in storage. In shape, size, and color it resembles

the Temple orange (the latter probably being a natural hybrid of the tangelo group), but has a smoother and tougher rind that is less likely to dry out or suffer injury from handling. It has, however, an entirely different flavor from the Temple orange and fewer seeds.

YALAHA TANGELO

(C P. B. 52016-K-12; pl. 5)

Resembling the Minneola tangelo in a general way, the Yalaha has about the same season of maturity but is not quite so striking a fruit. With its slightly roughened rind it resembles the Thornton, but in character of pulp, especially in acidity, it suggests also the Sampson. The rind character indicates good shipping and keeping qualities, especially for the late market in March and April or even later. It has been given the Seminole Indian name of Yalaha (Yä-lä'hä), from the town of that name in Lake County, Fla., where it has fruited for several seasons.

Technical description.—Fruit of shape and size of small grapefruit, $3\frac{1}{2}$ inches in transverse diameter by $2\frac{3}{4}$ inches in vertical diameter; calyx persistent, angular, set in slight depression with shallow radiating grooves in the rind; blossom end distinctly flattened with slight depression around pistil mark; color shading from orange (Ridgway, orange) at stem end to reddish orange (Ridgway, orange chrome) at blossom end; rind somewhat roughened and pebbly, in part due to large, deeply indented oil cells, of medium thickness (three-sixteenths inch), rather large open core; numerous slender seeds (20 to 25), greenish in cross section; segments 8 to 10; pulp tender, juicy, with little rag, of pale amber color (Ridgway, capucine buff), translucent; flavor rather acid until fully ripe, but a good blending of sweetness and acidity when mature. Tree evergreen, vigorous, and productive; leaves unifoliate, pointed oval with rounded base, resembling sweet-orange leaves, having narrow-winged petioles.

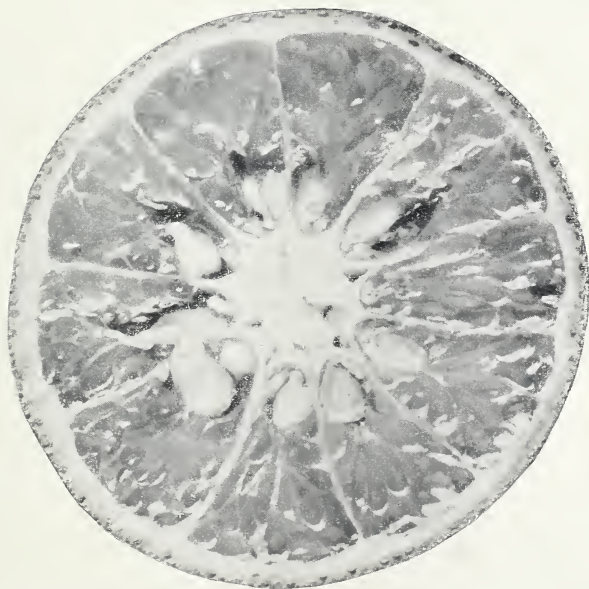
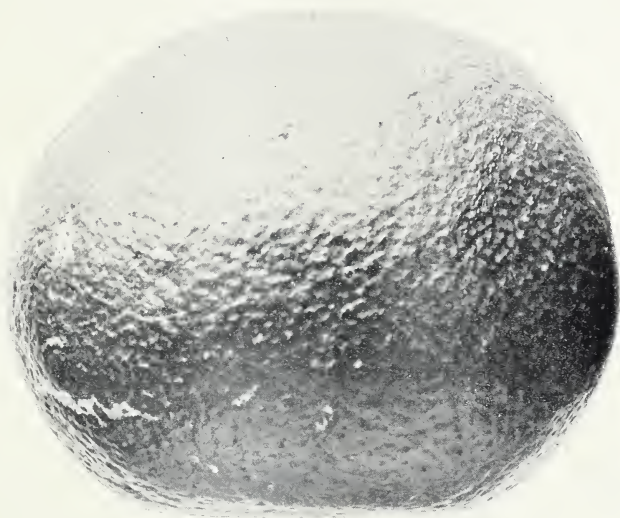
The Yalaha is perhaps the best of the late-maturing tangelos that have thus far fruited. The chief objections to it are the number of seeds and the size of open core. In young trees it is inclined to fruit in clusters, a habit that tends to produce pear-shaped fruits, but which is likely to disappear as the tree attains greater age.

CLEMENT TANGELO

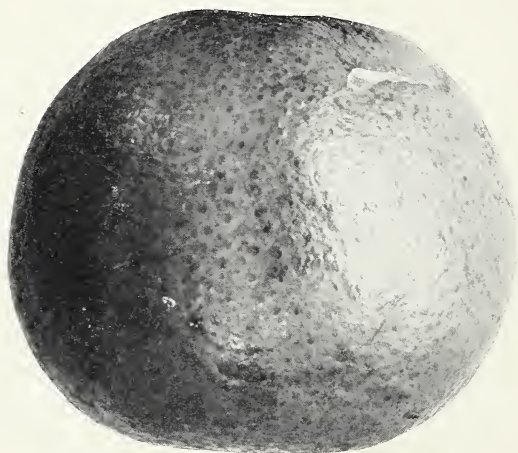
(C. P. B. 49855)

Aside from the tangelos of commercial importance, there are occasionally found among the numerous hybrids fruiting each year novel and interesting fruits which, although of little commercial promise, have a special appeal for the connoisseur because of some particular quality. There is a field for such fruits as luxury products or novelties, which justifies the propagation of such new types, at least for the home fruit garden or for the specialist in fruit production.

In a group of crosses between the grapefruit (as the seed parent) and the Clementine tangerine, some interesting fruits have been secured. These crosses are of special interest, as the pollen parent, the Clementine, is reputed by its discoverer, the late L. Trabut, to have originated as a natural hybrid between the Granito, a peculiar strain of the bigarade or sour orange, and the tangerine (13). It is classed, however, as a tangerine, being of kid-glove character and



Typical fruits of the Yalaha tangelo (C. P. B. 52016-K-12). (Natural size)



Fruits of the pink-fleshed Wekiwa tangelo (C. P. B. 47220). Pronounced color in cross section is derived from the pigmentation in the segment walls and inner rind rather than in the pulp vesicles. (Natural size)

developing a high color approaching the Dancy tangerine. The first introduction of the Clementine into the United States was in 1909 through bud wood sent by Doctor Trabut, who was chief of the botanical service of Algeria, to the senior writer, who propagated the variety at Glen St. Mary, Fla. The Clementine is the leading variety of the kid-glove group grown in northern Africa and is being planted to some extent in Florida, California, and southern Texas. The crosses with grapefruit in which the Clementine has been used as the pollen parent have resulted in a wide diversity of plants and fruits. These show greater hardiness than the Dancy tangerine crosses, a characteristic which accords with that quality in the Clementine. The fruits as a class are inclined to be loose skinned and rather puffy. One of the best of this group has been selected for propagation and has been named the Clement tangelo, as an indication of its relationship to the Clementine tangerine.

Technical description.—The fruits of this variety are rather variable in shape, from oblong oval to depressed globose, the size of a small grapefruit ($3\frac{1}{4}$ to $3\frac{1}{2}$ inches in diameter); calyx persistent, depressed area around calyx wrinkled and grooved; color grapefruit yellow with slight orange tinge (Ridgway, light orange yellow); rind soft, thick (one-fourth inch), with oil cells numerous, deeply indented, giving characteristic pebbled appearance, with some wrinkling, free peeling, large open core; pulp of peculiar soft jellylike consistency devoid of fiber and easily removed without squirting of juice, of pale amber color (Ridgway, capucine buff), pulp vesicles very small; segments 10 to 12, irregular in shape and size; seeds long and slender, number variable, usually one seed to a segment, occasional fruits entirely seedless; flavor mild and sweet, low in acidity but not insipid unless overripe; maturing in December and January. Tree evergreen, vigorous, and fairly productive; leaves unifoliate, medium to large in size, 4 to $5\frac{1}{2}$ inches in length, shape long-pointed oval with winged petiole, slightly recurved along midrib, resembling the Clementine leaf in this respect but to a less degree.

While this tangelo is not as striking in appearance as the others herein described, the finely wrinkled rind gives it individuality by which it may be recognized, and the "squirtless" character of the pulp, its smooth consistency, and mild flavor will recommend it to many lovers of citrus fruits.

WEKIWA TANGELO

(C. P. B. 47220; pl. 6)

In the course of making a series of back crosses, a pink-fleshed tangelo was secured as a result of using pollen of the Sampson tangelo on a seedling grapefruit. This unique hybrid was described by the writers in a previous paper (8), and fruiting trees are to be found in a number of citrus collections in Florida, although it is not recommended for commercial planting on a large scale. In the original description no formal name was assigned this fruit, but it has commonly been referred to as the pink tangelo. The name Wekiwa (We-ki-wa) is here given to it, after a famous spring in Orange County, Fla.

In making this back cross it was expected that the resulting hybrids would more nearly resemble the grapefruit, the seed parent. The male parent, however, the Sampson tangelo, proved dominant, the fruit bearing little resemblance to grapefruit but showing distinct tangelo character. This is not only true of the fruit itself, but is especially marked in the foliage characters. The small rounded

leaves, like the Sampson, are strongly constricted and recurved (boat shaped), giving the tree a peculiar appearance easily recognized. In several similar back crosses the pollen parent (Sampson tangelo) has proved dominant to a marked degree.

Like the Sampson, the Wekiwa tangelo comes true from seed, several seedlings fruiting at Indio, Calif., showing no variation from the parental form in fruit or tree characteristics.

Technical description.—Fruit variable in size, but usually of small to medium size, $2\frac{1}{4}$ to $2\frac{3}{4}$ inches in diameter, spherical or slightly flattened, occasionally pyriform; color resembling grapefruit (Ridgway, pl. 1, pinard yellow to primuline yellow), often having pink blotches, especially where fruits are in contact; rind thin or of medium thickness (one-eighth to three-sixteenths inch), smooth and glossy, oil cells conspicuous, large, and flush with surface, devoid of bitter principle common in rind of citrus fruits; segments 9 or 10, segment walls and inner rind tinged with color (Ridgway, peach red to Corinthian red) that appears to permeate the translucent pulp vesicles (which, however, are not so colored, but are amber in shade); seeds variable in number, usually averaging one to a segment, some fruits entirely seedless; pulp resembling grapefruit in appearance, with large, translucent vesicles, tender, juicy, very sweet, slightly aromatic, somewhat lacking in acidity but not insipid. Tree evergreen, rather weak grower, fairly productive; leaves small, 2 to $2\frac{1}{2}$ inches long, rounded oval in shape, peculiarly recurved or constricted, giving tree a characteristic appearance.

This fruit reaches maturity by early November but remains in good condition for several months. The pulp loses color, however, as it passes full maturity in late December. This earliness in maturing is in sharp contrast to the usual time of maturity of both parents, the Sampson tangelo being especially late in maturing. It is thus unique both for the pinkish color and for earliness, and has an extreme sweetness greatly relished by some.

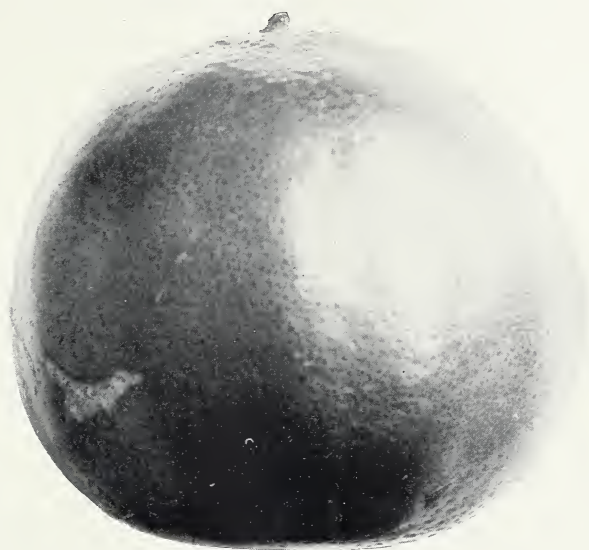
More recently a similar back cross (C. P. B. 52014-A-10, Bowen grapefruit \times Sampson tangelo) has given rise to another pink-fleshed hybrid that is smaller and generally inferior as compared with the Wekiwa tangelo, but resembles it in physical make-up.

Experiments in growing the Wekiwa tangelo in Florida have not encouraged its commercial planting, as it has not proved to be a thrifty tree, and it is usually somewhat dwarfed. A number of trees growing at the United States Experiment Date Garden at Indio, Calif., have not shown any such weakness, and the fruit has proved to be early maturing, holding well under the severe climatic conditions of that region. Despite the handicaps of small size and weak growth in Florida, the fruit is so relished by some people that it will probably be desired for home fruit gardens and for collections of varieties adapted to supplying a private trade.

SAN JACINTO TANGELO

(C. P. B. 1213-D; pl. 7)

Tangelos when grown in the coastal districts of California are usually found to produce small-sized fruits, rather mediocre in quality; however, a number of tangelos that have been tested at the United States Experiment Date Garden at Indio, Calif., in an extremely hot, dry climate suitable for date culture have produced larger and better-flavored fruits. Apparently the extreme climate of Indio is much more favorable to most tangelos than is the cool coastal climate of California.



Typical fruits of the San Jacinto tangelo (C. P. B. 1213-D) as grown at United States Experiment Date Garden, Indio, Calif. (Row 7, tree No. 38.) (Natural size)



Typical fruit of the Umatilla tangelo (C. P. B. 52031-B-2)
(Natural size)

The Thornton tangelo does well in the date country, making fruit of fair size and flavor, which ripens between Thanksgiving and New Year's Day. The Sampson tangelo, although sometimes showing slight sunburn of both leaves and fruit, usually produces a fair crop of medium-sized fruit that is juicy and of good flavor.

Several other tangelos have been yielding good fruits, especially a seedling of C. P. B. 1213, this number having shown little promise in Florida because of the "bottle neck" at the stem end of the fruit and its tendency to become insipid early in the season. The seedling of this number, C. P. B. 1213-D, grown at the Indio garden, however, has produced early ripening fruit of good size and flavor and of better keeping and shipping qualities than the Thornton tangelo growing alongside. The seed parent of this new fruit was a tangelo resulting from one of the early crosses in the same group with the Thornton, which it somewhat resembles.

Because of its first fruiting at Indio, in the general region of San Jacinto Mountain, a famed landmark guarding the pass to the Salton Basin, it is proposed to call this the San Jacinto tangelo.

Technical description.—Fruit round oblate, with slight depression at blossom end, usually with slightly raised area surrounding calyx, not constituting, however, a bottle-neck protrusion; size ranging from 3 inches in transverse diameter by $2\frac{3}{4}$ inches in height to $2\frac{1}{2}$ inches in transverse diameter by $2\frac{3}{8}$ inches in height; color orange yellow (Ridgway, orange buff to capucine yellow); rind fairly smooth and thin (about one-eighth inch), fairly free peeling though not loose; oil cells numerous, very minute and flush with surface, with some larger oil cells interspersed and slightly indented; segments 10 to 12, fairly large open core, one-half inch in diameter; seeds fairly numerous, 25 to 30, closely grouped at center, very small and slender, striate, with curved beak and greenish cotyledons; pulp of pale amber color (Ridgway, pale orange yellow), very juicy, translucent, and tender, little fiber, sprightly, subacid flavor, resembling the Thornton tangelo but when fully ripe having more character than a fully ripe Thornton tangelo; pulp vesicles irregular in shape and size and near the center more or less split open. Tree evergreen, vigorous, and productive; leaves unifoliate, pointed oval, variable in shape and size, small to medium size (averaging $2\frac{1}{2}$ to 3 inches long by $1\frac{1}{4}$ to $1\frac{3}{4}$ inches wide), petioles very narrowly winged, occasionally without abscission joint.

There are some differences between the seedlings grown under this number (C. P. B. 1213-D) at Indio, showing that this tangelo, unlike the Sampson and most of the citrus hybrids so far investigated, does not come true from seed. In order to connect this new variety with the parent tree producing the best fruit, it is here recorded that the parent tree is No. 38 in row 7 of the citrus experimental planting located at the United States Experiment Date Garden, Indio, Calif.

UMATILLA TANGELO

(C. P. B. 52031-B-2; pl. 8)

Closely resembling some of the tangelos in general appearance are certain of the tangors, i. e., hybrids between mandarin oranges (*Citrus nobilis*) and the common sweet orange (*C. sinensis*). The resemblance is so close that for horticultural purposes these tangors may well be discussed with the tangelo group, a class of fruits now fairly well recognized by citrus growers and rapidly acquiring market recognition.

Of special interest and promise is a fruit resulting from the polination of a Satsuma orange with pollen of the Ruby orange (some-

times called Ruby Blood). This cross was made in the spring of 1911 at Eustis, Fla. Hybrids of this group have been fruiting for several years at Eustis, and one has attracted special attention because of its large, deep-colored, glossy fruit of attractive appearance and good holding quality. In contrast with the parents (the Satsuma, early maturing, and Ruby, midseason), this hybrid is decidedly a late fruit, maturing in late February, March, and April, about the season of the King orange. It resembles the latter in shape and size, although it is much more attractive in appearance. The tree so strongly resembles the ordinary Satsuma in foliage and habit that but for the unique character of the fruit doubt might be raised as to its hybrid origin. The name Umatilla (Um-a-til'la) has been selected for this new fruit, after the town of that name in Lake County, Fla. For horticultural convenience it is classed with the tangelos.

Technical description.—Fruit the size and shape of a large Satsuma or King orange, flattened at base and apex but without depression, size $3\frac{1}{4}$ to $4\frac{3}{4}$ inches in transverse diameter by $2\frac{1}{2}$ to $2\frac{3}{4}$ inches high; calyx small, persistent, shallow grooves radiating from calyx attachment; color reddish orange (Ridgway, orange chrome), rind of medium thickness (one-eighth to three-sixteenths inch), firm, somewhat free peeling though not of pronounced kid-glove character; smooth and glossy despite slight indentations due to small, depressed oil cells; segments usually 10, separating easily, with thin segment walls; open core with slight quantity of fibrous tissue or rag; pulp tender and melting, translucent, very juicy, flavor rich and vinous with a blending of high acidity and sweetness somewhat resembling the King orange, pleasant aroma, large vesicles, color of pulp resembling orange (Ridgway, mikado orange); seeds variable but averaging one to a segment (some fruits entirely seedless), large and plump, greenish in cross section, like Satsuma. Tree of rather slow growth and spreading, with open top like Satsuma, fairly productive; leaves long-pointed oval, strongly veined, dark green, thick and leathery, with practically wingless petioles, resembling Satsuma.

A sister hybrid (C. P. B. 52031-C-2) closely resembles the Umatilla tangelo in fruit and tree characters, but its fruit is usually too acid for consumption until about a month after the Umatilla becomes palatable. Neither fruit shows any indication of drying out after reaching maturity, although the rind is very thin.

Until given further tests on different stocks for growth, vigor, and productivity, the Umatilla tangelo is not recommended for large-scale planting; but it is well worthy of a place in the home fruit garden and in plantings designed to supply luxury fruits to a private trade.

HYBRIDS SERVING AS SUBSTITUTES FOR LIMES AND LEMONS

The need for hardy and disease-resistant "ade" fruits similar to the lime and the lemon has led to making numerous crosses in which common varieties of both lime and lemon have been utilized in combination with hardy and disease-resistant citrus varieties and species.

One group of these hybrids, the limequats, has been discussed in a previous paper, in which three varieties—the Eustis, Lakeland, and Tavares—were described in detail (9). In producing these hybrids the common West Indian lime (*Citrus aurantifolia*) was pollinated with pollen from two species of the kumquat (*Fortunella margarita* and *F. japonica*).

Since the publication of the paper mentioned above, the Eustis limequat has been propagated and planted in home fruit gardens in Florida and in the other Gulf States and has fulfilled all expectations as to hardiness and disease resistance. The limequats are to all practical purposes hardy limes, but with the added advantage that the hybrid has proved immune to lime withertip, a specific lime disease caused by a parasitic fungus (*Gloeosporium limetticum* Clausen) (2) to which the pollen parent (*Fortunella japonica*) is immune. The severity of this disease, especially in humid regions and in seasons of high rainfall, seriously reduces the vigor of the trees and causes great crop losses, so that an immune variety having much the same flavor has distinct economic promise.

The relative vitamin value of the hybrid as compared with the common lime is likewise a matter of importance and is now being investigated. The lime, as is now well known, has the lowest vitamin value of any citrus fruit, notwithstanding its traditional use on old sailing vessels as a preventive of scurvy. The so-called "lime juice" served as a ration to the crews of vessels on long cruises was not, however, the juice of the West Indian lime, but a mixture of lemon juice and juice of the so-called sweet lime. So much a part of the regimen was the serving of this juice on British vessels that they earned the sobriquet of "lime juicers." The substitution of juice from the West Indian variety of lime under the mistaken notion that it was identical in its properties with the juice of Mediterranean limes and lemons led to several deaths from scurvy, seriously handicapping an important expedition to the Arctic regions—the Nares expedition of 1875–76 (1).

The limequat has evinced an adaptability to a wider range of conditions than the true lime, not only thriving in regions much too cold for the common lime, but proving well adapted to growth in such widely divergent climates as the hot desert valleys of southeastern California and the humid tropical lowlands of Honduras and Panama. Although the limequat proved sufficiently hardy to overwinter for a number of normal years in northern Florida and the other Gulf States, the severe freeze of 1924 practically killed out the limequats planted in this territory, indicating the need for a still hardier "ade" fruit for this and similar marginal citrus zones.

A CALAMONDIN HYBRID

GLEN CITRANGEDIN

(C. P. B. 48045; pl. 9)

The calamondin (*Citrus mitis* Blanco) has proved to be a surprisingly hardy citrus species, especially in view of its native habitat, the Philippine Islands. The tree is vigorous and productive; the small red acid fruits, of kid-glove character, are decidedly ornamental; and the fruits make an acceptable substitute for limes or lemons in regions that are much too cold to grow those fruits. The calamondin, however, is not entirely hardy in northern Florida and in the Gulf coast regions farther west, such freezes as occurred in 1924 almost annihilating existing plantings. Moreover, young trees are often injured by temperatures of about 20° F., which are not uncommon in these regions.

The calamondin has been utilized in a number of hybrids, the most promising of them being one in which it was pollinated with pollen of the Willits citrange. This citrange, which has been previously described (14, 15), is itself a hybrid, resulting from pollinating the Japanese trifoliolate orange (*Poncirus trifoliata*) with pollen of the common sweet orange (*Citrus sinensis*). The citranges as a class are the hardiest of all evergreen citrus varieties or hybrids, but the fruit usually retains an objectionable quantity of musky oil, derived from the trifoliolate parent, that necessitates special precautions in using the rather acid fruits for "ade" or preserves. Most of the hybrids in which the citrange has been utilized have traces of this flavor—much reduced, however, as in the Thomasville citrangequat (9), a hybrid of the oval kumquat (*Fortunella margarita*) and the Willits citrange. By hybridizing the Willits citrange with the calamondin, however, a fruit has been produced that is fully as hardy as the citrange parent but entirely free from the pungent oil usually associated with hybrids of trifoliolate orange ancestry. The tree, however, so closely resembles the common calamondin that some doubt might be raised as to the hybrid nature of the plant but for the occurrence of trifoliolate leaves, especially in the juvenile stages, combined with much greater hardiness and greater vigor of growth, as compared with the ordinary calamondin.

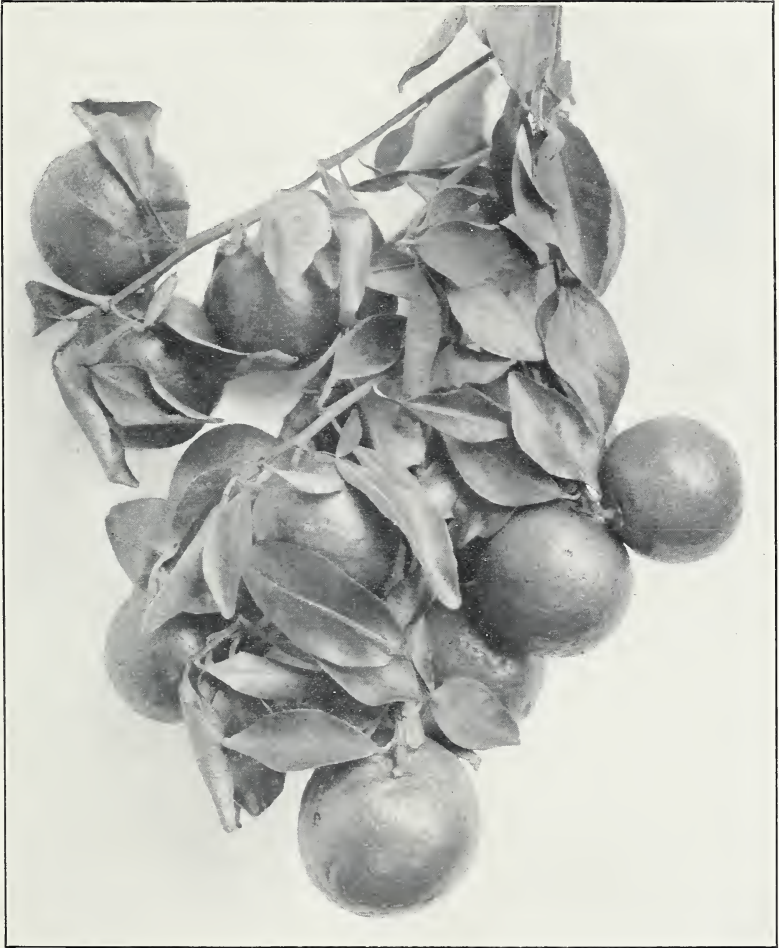
This hybrid was the result of a cross-pollination made by the senior writer in the spring of 1909 at Glen St. Mary, Fla. Mature trees have been fruiting with great regularity at Glen St. Mary for some years past and have survived freezes that severely injured the ordinary calamondin and the limequat. More than 100 miles farther north, at McRae, Ga., this hybrid has also fruited well, and the fruit has been reported as acceptable at the local soda fountains for use in preparing "limeade," which can scarcely be distinguished from the true limeade.

As this fruit originated at Glen St. Mary, where it has long been fruiting, it is proposed to call it the Glen citrangedin.

Technical description.—Fruit somewhat variable in size, oblate-spheroid, $1\frac{1}{8}$ to $1\frac{1}{2}$ inches in transverse diameter by 1 to $1\frac{1}{4}$ inches high, small persistent calyx set in slight depression, minute nipple at pistil end; color deep reddish orange (Ridgway, cadmium orange); rind thin and firm (one-eighth inch in thickness), not as free peeling as the calamondin and somewhat coarser, smooth and glossy, except for slight indentations due to numerous minute oil-cell depressions; segments 6 to 8, separating easily; small solid core; pulp juicy, tender, and translucent, very sharply acid but without trace of the repugnant oil usually encountered in hybrids of the trifoliolate orange, color of pulp orange yellow (Ridgway cadmium yellow); seeds small and plump, 3 to 5, some fruits seedless. Tree evergreen, of vigorous upright habit, highly ornamental, especially when bearing a crop of bright-colored fruits; leaves usually unifoliolate, occasional bifoliolate and trifoliolate leaves appearing, dark green, glossy, $1\frac{1}{4}$ to $2\frac{1}{4}$ inches in length, long-pointed oval, petiole narrowly winged and long in comparison with leaf size.

The tree has the habit, more pronounced than in the true calamondin, of bearing its fruit in clusters at the ends of long slender branches, bending the tree over with the weight of the fruit.

In regions too cold for growing the limequat or the ordinary calamondin with safety, this hardy fruit, the Glen citrangedin, offers an attractive and useful substitute. It is, of course, chiefly of service in preparing "ades" and in flavoring, much as lemons or limes are used. When not intended for immediate use, the fruit should be



Fruits of the Glen citrangedin (C. P. B. 48045). (About one-half natural size)



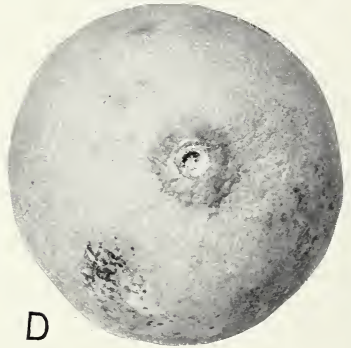
A



B



C



D

Typical fruit of the Perrine lemon (C. P. B. 48848). A, cross section; C, whole fruit; D, stem end. Compare Eustis limequat (B). (All about two-thirds natural size)

picked in the yellow or green-yellow stage rather than when red, as the small, fully ripe fruits tend to shrivel rather rapidly when held at ordinary storage temperature.

The tree is more or less everbearing, although the bulk of the fruit matures in the late summer and fall months. Owing to its small size, the fruit freezes at temperatures only slightly below freezing, so it can not be held on the trees over winter in cold sections. Most of the trees thus far fruiting have been budded on the trifoliolate-orange stock, and this doubtless has added to their hardiness. The tree should be grown on this stock or on the hybrid citrange in the colder sections of the Gulf coast and coastal-plains area of the South.

Like the true calamondin, this new fruit has value as an ornamental when grown as a dwarf or potted plant.

A LEMON-LIME HYBRID

PERRINE LEMON

(C. P. B. 48848; pl. 10)

Lemon culture has never been an important part of fruit growing in Florida, several factors contributing to the failure of lemons to succeed as a marketable crop under conditions there. A leading factor is that Florida lemons grow too big and coarse by the time they are ripe enough to pick. For marketing purposes lemons are picked by size, usually green, and cured to a proper color in special curing rooms before shipment. Under Florida conditions the lemon commonly reaches the desired market size when it is still too immature to be a desirable fruit, lacking both juice and flavor. Of equal importance is the extreme susceptibility of the common lemon to citrus scab, which reduces the yield and lowers the grade of the fruit. It is especially difficult and expensive to control this disease on lemons. As a result, lemons are frequently scarce in Florida, imported Sicilian lemons in part supplying the deficiency during the greater part of the year. Several hardy substitutes for the lemon that are of much merit are gradually coming into cultivation, such as the Eustis limequat and the Meyer Chinese lemon (4) (a hardy type probably of hybrid origin); but there is still a demand for a lemon that can be grown in the warmer parts of Florida for local use, if not as a shipping crop.

Hybrids between the Mexican lime (*Citrus aurantifolia* (Christm.) Swingle) and the Genoa lemon (*C. limonia* Osbeck), made by the senior writer in 1909, have been fruiting for several years in Florida and give promise of meeting local needs. Although the Mexican lime was used in these crosses as the female parent, the fruits are more like a true lemon in appearance. The pulp in color, texture, and, to a less extent, in flavor shows the influence of the pollen parent. One of these hybrids in particular (C. P. B. 48848) is decidedly lemonlike in character and has been selected for propagation and planting. Despite its hybrid character (being technically a "lemon-lime"), its close resemblance to the lemon justifies its being treated horticulturally as a new variety of lemon. As this fruit has especial promise for the warm region of the lower east coast of Florida, where it first fruited at Little River, it is proposed to name it in honor of the pioneer horticulturist of this region,

Henry Perrine, to whom Congress in 1838 made a large grant of land for planting to tropical plants, and who is reputed, among many other introductions, to have planted seed of the Mexican lime on several of the Florida keys, the beginning of the so-called wild lime groves of this region. This new fruit, a hybrid between the lime he introduced and the lemon, is therefore named the Perrine lemon.

Technical description.—Fruit, size and shape of ordinary lemon, although somewhat variable, average fruit $2\frac{3}{4}$ to 3 inches in length by $2\frac{1}{4}$ to $2\frac{3}{4}$ inches in diameter, having abrupt protuberances surrounding calyx and small nipple at blossom end characteristic of lemon; pistil often persistent; color pale lemon yellow (Ridgway barium yellow to pale lemon-yellow); rind thin and tough, one-eighth inch, fairly smooth, slightly corrugated or wrinkled; segments 10 to 12; small solid core, thin segment walls, vesicles very small and tender; pulp very juicy and translucent, of pale greenish yellow color (Ridgway pale dull green-yellow), suggesting lime; flavor more like lemon than lime, sharply acid with no "off flavor" or after taste; seeds variable in number, usually 4 to 6, sometimes up to 12, slender and long pointed; tree evergreen, vigorous, productive, and precocious; of rather compact habit, resembling the lime in this respect rather than the lemon; leaves unifoliate, large (3 to 5 inches in length), pointed oval, with short wingless petiole, resembling the lemon leaf. The tree is much more hardy than the lime and appears somewhat hardier than the common lemon; more or less everbearing, having ripe fruit, fruit in all stages of development, and newly opened flowers at the same time. Juice is developed while the fruit is still green and immature, in which respect it resembles the lime. The fruit, like the lime, when fully ripe drops to the ground.

Outstanding in its behavior under Florida conditions is its resistance, if not complete immunity, to two of the worst diseases that attack, respectively, the lime and the lemon—lime withertip (2) and citrus scab (3, 16, 17). In April, 1930, experiments were conducted at the United States Citrus Disease Field Laboratory, Orlando, Fla., under the direction of H. R. Fulton, to determine the reaction of the Perrine lemon to lime withertip. The report of H. E. Stevens, who made these tests, is as follows:

Attempts were made to induce withertip on 12 young growing shoots. Active withertip-infected shoots from Key limes were placed in contact with the above under conditions favorable for the disease to develop, but no infections were obtained on any of the shoots so treated.

Under conditions extremely favorable to scab infection, no scab has thus far appeared on fruit or foliage of the Perrine lemon. Inoculation experiments are in progress to test further this apparent immunity. Freedom from both these diseases constitutes an asset of extreme importance in attempting to grow a fruit of this character in southern Florida, where the high temperatures and humidity are favorable to their spread and render their control difficult and costly. This combination of characters is doubtless due to the fact that the common lemon is immune to lime withertip (2) and the Mexican lime is immune to citrus scab (16, 17), the hybrid inheriting both immunities.

The acid content of the fruit⁵ has been found to be 6.39 per cent as compared with 5.17 per cent in the Villa Franca lemon and 6.89 per cent in the Key (Mexican) lime, these percentages representing content of anhydrous citrus acid.

⁵ Determined and reported by B. R. Fudge, assistant chemist, Citrus Experiment Station, Lake Alfred, Fla.

A sister hybrid, C. P. B. 48839, closely resembles the Perrine lemon in fruit and tree characters, but the fruit shows more influence of the lime parent and is often so asymmetrical in shape as to be poorly adapted to packing. The tree, however, has the open habit of the lemon rather than the compact habit of the lime, a disadvantage from the cultural viewpoint, and likely to make it less resistant to cold. Both of these fruits, however, are well adapted to the home fruit garden in the warmer parts of Florida.

SUMMARY

The tangelos and one related fruit (called tangor) represent a new type of orangelike citrus fruits having very high quality combined in many cases with extremely attractive appearance. Despite the fact that tangelos have been created by hybridizing tangerine oranges with different varieties of grapefruit, the resulting hybrids do not resemble their parent species as much as they do oranges; in fact, they seem very much like some new and superlatively excellent varieties of oranges rather than like hybrids of tangerines and grapefruits.

Tangelos are usually characterized by extremely soft and melting pulp of very fine flavor, frequently with a special and often pleasing aroma which makes them highly prized by those who have had an opportunity to test them.

The soft and melting pulp of the tangelo in many cases causes the fruit to break down rapidly when shipped to distant markets. The rind of some varieties is so thin and tender as to be poorly adapted for handling by the ordinary packing-house method. This objection is largely overcome in several of the new tangelos herein described.

The extremely high-flavored and abundant juice of many tangelos makes them especially well adapted for use as juice fruits, either by themselves or blended with orange or grapefruit juice. Without doubt, tangelos are destined to become important for use as juice fruits, especially for local markets in regions visited by winter tourists.

Some of the tangelos are of such beautiful appearance and have such exquisite flavor and pleasing aroma that they constitute luxury fruits of the first order and as such justify the extra expense of special handling while being picked, packed, and shipped to distant markets. Such fruits can not be sold at a profit except at a much higher price than ordinary oranges.

Although tangelos are extremely promising for the home fruit garden in citrus-growing States and may ultimately be shipped on a small scale to luxury markets in distant cities, it is not advisable at present to make extensive plantings of them, on account of the difficulty of marketing these new fruits to advantage in car-lot shipments.

The Glen citrangedin, obtained by hybridizing the Willits citrange with the calamondin, is a remarkable new acid fruit which combines to a large extent the extreme hardness of the citrange parent with the high acidity and excellent flavor of the calamondin. It has been grown successfully as far north as McRae (latitude 32°), in southern

Georgia, and can endure more winter cold than any other acid fruit of good quality yet studied.

Unlike the citrange, the Glen citrangedin has a sharp acid flavor without a trace of the repellent bitter flavor carried by oil globules in the interior of the pulp vesicles of the citrange. It is not only an excellent "ade" fruit for home use and for local markets, but also has high ornamental value if grown as a dwarf or potted plant. On account of its extreme hardiness it should be tested throughout the warmer parts of the Gulf coast and also in southern and southeastern Georgia, southern Texas, and possibly in the cooler irrigated valleys of Arizona where lemons, limes, and even limequats do not succeed.

The lemon-lime hybrid, called the Perrine lemon, was originated by crossing the common Mexican lime with the ordinary lemon. It is more like a lemon than a lime in appearance, but unlike the true lemon it does not grow to large size and become coarse and puffy when grown in Florida. It has thus far proved highly resistant, if not completely immune, to two major diseases, lime withertip and citrus scab. The Perrine lemon is suitable for culture in southern Florida and possibly in home fruit gardens in the warmer parts of Louisiana and southern Texas. It is apparently hardier than either the West Indian lime or the common lemon.

Neither of the citrus fruits serving as substitutes for limes and lemons is recommended for large-scale commercial culture at the present time, but both should be tested in the home garden.

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