New Types of Citrus Fruits for Florida

Mr. President, Ladies and Gentlemen:

I had the pleasure of presenting to the members of this society at the meeting at Daytona last year some of the results of the recent work in the breeding of new types of citrus fruits. I spent the months from March to June last spring in Florida making hybrids with a view to securing new types of citrus fruits, some of which I shall discuss in this paper.

The work heretofore done in connection with the breeding of hardy citrus fruits has not been of a character to interest directly the orange growers of central and southern peninsular Florida. The hybrids between the trifoliata and the common orange (citranges, as we call them) are not of a type likely to prove a success for commercial culture, although excellent for home use throughout the cotton states, and are of comparatively little interest in regions where oranges, lemons and limes can be grown.

I have had the feeling that many of my Florida friends, although somewhat interested in the work, have considered that it did not directly concern them. I believe that the results which I shall discuss today will convince you that there is a side of this work which has a direct personal interest to every orange grower in Florida.

Three-Quarter Hybrids.

Last year I showed the members of this society photographs of some of the hybrids obtained by Mr. E. M. Savage the year before by crossing the citrange back with one of its parents, thereby securing hybrids containing 3-4 orange and 1-4 trifoliata. These citrangors, as we call them, show considerable variation, some having distinctly trifoliolate and others entire leaves like the orange. The studies made during the past year have convinced me that the pollen grains of the citrange have a great range of diversity; some being practically of the orange type and others partly trifoliata, consequently the Citrangors show almost every type from half-blood orange to trifoliolate and from citrange to practically pure orange, showing only minute traces of trifoliolate blood. It is obvious that in this way we secure hybrids showing all variations of trifoliata blood and there can be but little doubt that a slight touch of the trifoliata would be likely to add an agreeable zest to the fruit and besides give additional hardiness to the tree. I have secured photographs of three or four of the more diverse types of Citrangors so that members can see something of the extent of variation in this type of hybrid.
SECOND GENERATION CITRANGES.

When the citranges (trifoliata by common orange) were first made it was not expected that the first generation hybrids grown from seed secured by such cross pollination would be of any value, while it was confidently expected that the second generation hybrids grown from seeds of the citranges themselves would show occasional combinations of the qualities of the two parents which would make them valuable. The unexpected is said always to happen, however, and it certainly did in this case. Many of the first generation citranges proved distinctly of value for home use in the Cotton States. Some of them were nearly seedless so that it was difficult to try the experiment of securing second generation seedlings. Others, however, seeded very freely and upon growing the seedlings they were seen to be monotonously uniform, reproducing almost exactly the parental type.

Among the 14 or 15 citranges now in fruit, 2 have been found that occasionally give rise to true second generation hybrids, and 2 more the seeds from which all give rise to second generation hybrids. These citranges, it is true, are not among the best varieties, but one of them is of fair quality and the other is of large size and handsome appearance though of unusually bitter flavor. The seedlings of these citranges show the most extraordinary diversity, ranging all the way from practically pure orange to practically pure trifoliata, with every conceivable intermediate stage. It is almost impossible to find duplicates among the scores of plants now under observation. They show much the same variation as the Citrangors already referred to but have vastly wider range, the Citrangors having as their two extremes the citrange on one side and the orange on the other, while the second generation seedlings range from orange to trifoliata, a much wider field. Then, too, the second generation seedlings are secured without any further trouble than the mere planting of the citrange seeds; all that is necessary is to propagate the two varieties of citrange mentioned and then plant the seed. In this way a wealth of new citrus fruits can be obtained and, what is of interest to the Florida citrus growers, many of these new fruits approach the orange very closely in character of leaf and in growth and will doubtless bear fruits distinctly of the orange type although at least some of them may be expected to show something of the hardness of the trifoliata in the tree and perhaps some of the earliness of this parent in the ripening of the fruit. Photographs are attached showing something of the amount of variation seen among the seedlings of these two varieties of citranges; also photograph showing a few older seedlings of the rustic citrange planted in the fall of 1908, and giving some idea of the appearance of these second generation citranges as they get older.

It should be stated, in this connection, that long experience has shown conclusively that much can be judged as to the character of the fruit of a citrus plant from the appearance of the leaves. Of course, the Citrangors and these second generation seedlings will be forced into fruit as soon as possible, and I hope within a couple of years to give the first actual
demonstration of the truth of what is here announced.

COMPLEX CITRUS HYBRIDS.

Besides the two classes of citrus hybrids mentioned above there is a third containing a small proportion of trifoliata blood, which is likely to be of decided interest in Florida. These hybrids have been secured by crossing citranges with other citrus fruits not entering into the parentage of the original hybrid; that is, citranges have been crossed with the grapefruit on one hand, with the hope of securing new types of citrus fruits suitable to be eaten from the hand but still having some of the hardiness of the trifoliata; and with the kumquat on the other hand in the hope of securing hardy forms of acid fruits suitable for making ade. The kumquat has one important type of hardiness, ability to resist spells of hot weather in winter without starting into growth; while the trifoliata is able to withstand very severe cold when in a completely dormant condition.

VIGOR OF GROWTH OF CITRUS HYBRIDS REMARKABLE.

An interesting thing has developed in connection with these hybrids: Citranges are more vigorous than either the orange or the trifoliate parent, often growing as rapidly as the combined growth of both parents. The Citrangors and second generation citranges do not show this excessive vigor, most of them being about as vigorous as the parent they most resemble; that is, second generation citranges that look like oranges grow about as rapidly as the orange.

When citranges are crossed with a third species, especially if it is very different, such as the grapefruit or kumquat, then the hybrids which really represent a commingling of three species, show extraordinary vigor, in some cases nearly equaling in growth the combined growth of all three parents. For example: A kumquat flower crossed June 6, 1909, with pollen of the Rusk citrange, the fruit being picked the latter part of October, 1909. The seeds were planted in the greenhouse of the Department of Agriculture on October 28th, sprouted within a week and in six weeks the young plants were strong enough to be inarched on two-year-old grapefruit stock. From the moment these seedlings appeared above the ground they have not ceased growing and are now from 2 1-2 to 3 feet high, as large as most citrus seedlings two years old, although they are barely six months old from the time of germination.

Some of the hybrids made between the citrange and the Satsuma show something of this unusual vigor, which is to be expected since the Satsuma is rather different from any of the other citrus fruits.

At any rate, here we find a method of securing extraordinarily vigorous hybrids combining the qualities of three parental species.

It should be stated, as mentioned in connection with the Citrangors, that the pollen of the citrange shows a wide range of character. If crossed on the grapefruit, for example, some of the plants look much as if they were crosses between the orange and the grapefruit, while others are much like crosses between the tri-
foliate and grapefruit, with all conceivable intermediates. The same is true of the kumquat and Satsuma crosses.

In order to secure the great energy of growth just referred to it is necessary that a distinctly different species of citrus fruit be used in the cross. If asked if it is possible to go a step farther in this, the answer is that this depends upon our ability to find still more diverse types of citrus fruits than we now have. This I am glad to say has been done. Within the past year the investigations conducted by the Department of Agriculture has brought to light the existence of at least two or three entirely unsuspected types of citrus fruits. One is a hardy kumquat growing in the deserts of Australia and able to stand temperatures but slightly above zero. It bears small, edible fruits of the type of the round kumquat. As we have found the kumquat to be extremely useful in complex hybrids there is much to be expected from this desert kumquat.

A giant kumquat, or at least a species of fruit more closely allied to the kumquat than anything else we know of, has been found to grow in Burma, the Malayan Archipelago and the Andaman Islands. This tree grows to a height of from 25-30 feet and bears a fruit from 1 1-2 to 2 inches in diameter.

There has also been brought to light in tropical Africa a whole group of edible citrus fruits of a new type. The trees have compound leaves with from three to seven leaflets. The leaves themselves are of gigantic size, sometimes 1 1-2 feet long and 1 foot wide, the individual leaflets being much larger than any ordinary citrus leaf. The fruits are small but sweet and of good flavor.

Here, then, are three new types of citrus fruits which, when secured, can be used in complex hybrids with strong probability of securing great vigor among their descendants. The kumquat, though a dwarf plant, has yielded extraordinarily vigorous seedlings when crossed with the citrange—very much more vigorous than would be secured by crossing the citrange with even the largest and most vigorous type of orange.

**TANGELOS.**

One of the first crosses made by the writer some twelve years ago was that between the tangerine orange and the grapefruit. This was a lucky strike since it gave rise to the Sampson Tangelo which represents another valuable new type of citrus fruit. When oranges of the loose skin type are crossed with grapefruit the hybrids often produce fruits almost entirely destitute of the bitterness of the grapefruit but still containing much of the agreeable sprightliness of the latter. Some of the Tangelos are thin-skinned and almost all are of good flavor.

In this connection, the experience of Mr. A. Aaronsohn, Director of the Jewish Agricultural Experiment Station at Haifa, Palestine, is of interest. Himself a grower of the Jaffa orange and coming to this country unfamiliar with the grapefruit, he told me that after becoming accustomed to the latter he had practically lost his taste for the orange which seemed insipid after once he had tasted the delicious sprightliness of the grapefruit.
Experiences of this nature make it seem probable that the Tangelos will be found to be the orange of the future. It should be said that they are much more like a good sweet orange than anything else but are distinctly different in having more zest and sprightliness. Very few people, seeing a good tangelo for the first time, would guess correctly its parentage. In view of the great promise of this hybrid a large number of crosses have been made between all available types of kid glove oranges and the best of our grapefruits. Hybrids are also being made with the Chinese grapefruit which, although it is thick-skinned and less handsome than our own, has in the opinion of some persons a distinctly better flavor.

Certain comparatively unknown small hardy oranges of the Satsuma (kid glove) type from Japan are also being used in these crosses, since it has been found that small-fruited parents do not necessarily make small-fruited hybrids. This Tangelo breeding is, perhaps, the most promising field of all from the standpoint of the Florida orange grower.

BREEDING GRAPEFRUITS.

The grapefruit is perhaps the greatest of the Florida fruits, but as everybody knows it has by no means reached the high state of perfection attained by the orange. Most varieties are very seedy, and even if not, have some drawback or other. There is every reason to believe that radical improvements will be made in the grapefruit when once its breeding is taken up in a systematic manner.

Mr. David G. Fairchild of the U. S. Department of Agriculture, has given much attention to the securing of new types of grapefruit from all parts of the Old World, particularly from China, Siam and India. Many of these varieties are now fruiting, and although most of them are distinctly inferior to our own grapefruit, some possess certain desirable qualities. It is believed that the hybridizing of these with our own grapefruit will be likely to yield extremely valuable new varieties. At the same time crosses are being made with the *trifoliata* in the hope of securing second generation *trifoliata*-grapefruit crosses resembling the grapefruit in general characters but partaking somewhat of the hardiness of the *trifoliata*. Such hybrids would very likely be less seedy than the fullblood grapefruit.

TESTING NEW STOCKS FOR CITRUS FRUITS.

A botanical survey has been made of the relatives of the Genus *Citrus*. Some 80 species of plants, belonging to 19 different genera, may be considered as close relatives of our common citrus fruits. These for the most part are closely enough related so that they can be grafted on each other, while many of them are so closely related that it will be possible to hybridize them with each other and with our ordinary citrus fruits.

Some of these are so unlike the orange that hybrids would not be of any value for their fruits even if they could be crossed successfully. Some, however, are very vigorous growing trees and have been found (at least in the greenhouse here) to be the best stocks upon which to graft our common citrus fruits.

Inasmuch as the orange blight is now strongly suspected to be a root disease, it
is my hope that some of these very diverse types may prove resistant to the blight and at the same time be excellent stocks in every other respect. The accompanying photographs show all the ordinary citrus fruits growing on a remarkable citrus relative from the Philippines—the Tabog or Philippine Baelfruit. This has trifoliate leaves and bears a hard shelled fruit, utterly unlike the orange in that it is filled with a very aromatic and juicy pulp and has seed chambers filled with gum. Nevertheless, as can be seen from the photographs, this promises to be a most excellent stock and is among the most rapid growing of all the many citrus relatives that we have tested in our greenhouse.

In this way the work will be carried on in the most efficient manner. The making of hybrids will be largely done by experts who have acquired great skill in the work; the propagation will be undertaken by other experts who, thanks to the greenhouse facilities at Washington, can push such seedlings much more rapidly than is possible out of doors in Florida; while the testing of the fruits will be put in the hands of expert growers who are best able to look after this phase of the work.

DISCUSSION.

Mr. Thompson: How many of the growers have gotten these citranges and what has been the result from their growth?

I would say that I secured four from the government and we planted them as we did the ordinary stock, and results have been far from satisfactory. They have not made a very good growth. The soil is the same as for trees that have outstripped them four times.

Mr. Skinner: I received some citranges, and the Sampson Tangelo has done very well. The trees look thrifty, but have not made as much growth as our trees generally make, but they seem to be doing fairly well and have a good, thrifty appearance. However, the soil is very poor high pine land.

Mr. Gal-
loway, visiting Winter Haven, was very favorably impressed with the fruit from these trees. One tree is full of fruit that has changed but very little. We expect it to carry its fruit until late in July this season.

Mr. Temple: I understood the gentleman to ask what experience any of the growers had had with the trifoliata base on high pine land. If that was the question, I have had some experience with it and am perfectly willing to give it to you.

About six years ago, I bought one thousand buds of trifoliata stock—kumquats, grapefruit, King oranges and half a dozen other. While the King did fairly well, the kumquats did exceptionally well, but above all things the successful one was the grapefruit. I have over 200 grapefruit trees on trifoliata stock that we set out close together because we were given to understand that they would not make very large trees. I have already had to take out every other tree, and will have to take out every other tree again.

Last year, which was five years from the planting of these buds, we picked and marketed four and one-half boxes of grapefruit to the tree from every one of the grapefruit budded on trifoliata.

Prof. Hume: I think we must concede that Prof. Swingle is bound to win out. Some of us have had our doubts about it, but I must say that I believe if he lives long enough and works hard enough, he is going to succeed. Those of us who know Prof. Swingle, are sure that he will work hard enough, and we all hope he will live long enough to bring about this result—and then some.

I believe one of these days he will present us with an orange tree that will stand temperatures we have not dreamed of.

Dr. Inman: I would like to ask Mr. Temple how his trees have withstood the recent cold we have had.

Mr. Temple: Not only the recent cold does not seem to have affected that grapefruit, either the tree or the fruit, any more than it has the orange trees on the place, but in truth the trifoliata grapefruit shows less effect from the frost than the grapefruit we have there which were seedlings, or budded on the lemon or sour stock.

Mr. ———: What soil is it?

Mr. Temple: What you would call high hammock—that is, pine with some oak growth interspersed through it.
PLATE I.

1. Orange-like Plant.

2. Orange-like Plant With Narrow Leaves and Long Petioles.

4. Broad Leaved Citrange-like Plant.

5. Normal Rustic Seedling, Showing Parent Type of Foliage.
Showing Variation in Second Generation Citranges. (1) Seedling Orange; (2) Seedling Trifoliatas; (3) Seedling Citrange, Intermediate Type, About Like the Parent Citrange.
Figs. 1-5 Show Second Generation Citranges, Varying From Orange-like to Trifoliata-like.
Six-Months-Old Seedling Citrangequats. Obtained by crossing the Oval Kumquat With the Rusk Citrange; Plant Inarched on Two-Year-Old Grapefruit Stock When about 6 Weeks Old. Photograph Taken Six Months From Time Seed Was Planted.
PLATE VI.

Fig. 14. Citrangors Produced by Mr. E. M. Savage at Glen St. Mary, Florida in the Spring of 1908 by Crossing Citrange No. 746 (See Plate 7) With Pollen Taken from a St. Michael Orange Tree. Some of the Seedlings Are Simply False Hybrids; Others Show Leaves Almost Exactly Like Those of the Common Orange Although They Certainly Contain One-Quarter Trifoliate Orange Blood and Will Probably Prove Hardier Than Any Existing Varieties of the Orange.
Tabog (Philippine Bael Fruit), a Very Promising Stock. One-Half Natural Size.

Fig. 16. Citrangor (3-4 Common Orange, 1-4 Trifoliolate) Obtained by E. M. Savage in 1908 by Crossing Citrange No. 75 With Parson Brown Orange. Next to Top Leaf on Right Shows Trifoliolate Influence. Note the Orange-like Leaves.