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THE SATSUMA ORANGE

BY

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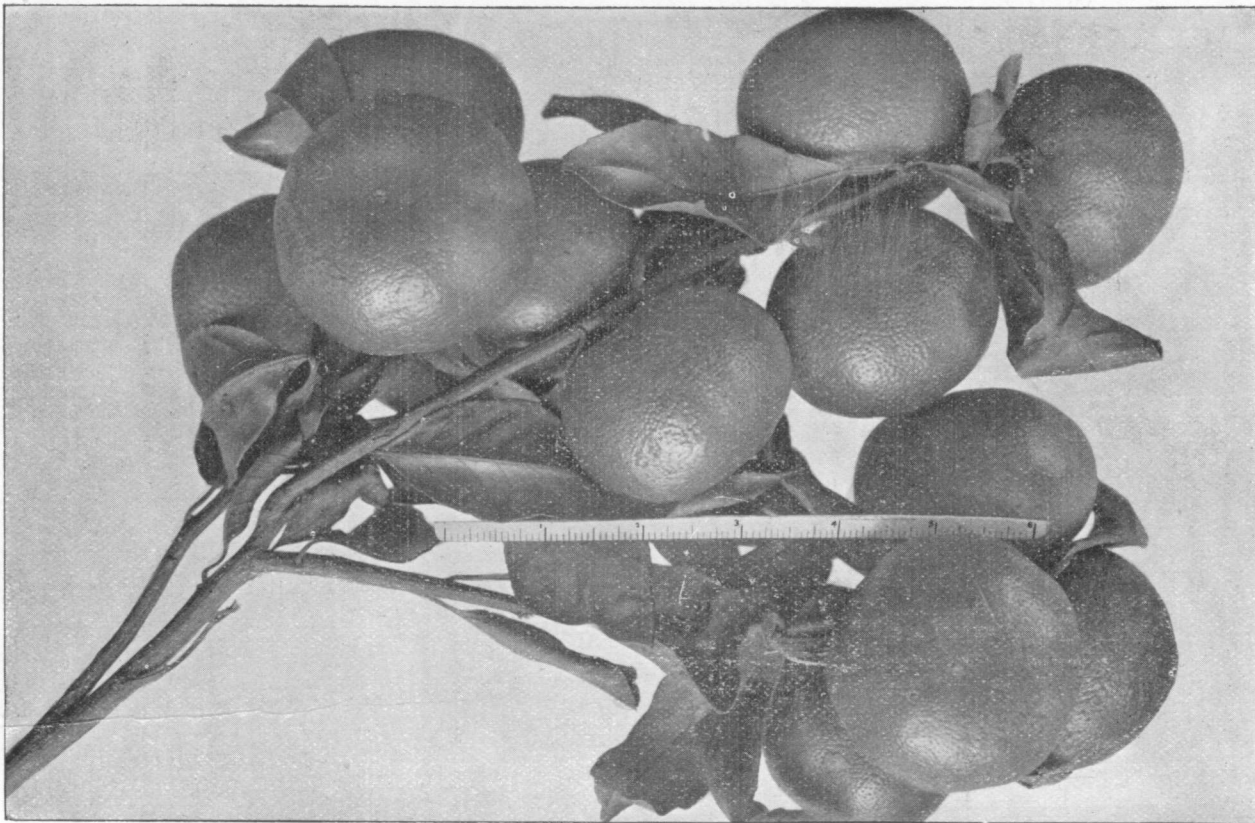


PLATE I, A cluster of Alabama Satsumas, showing their shape and relative size. (Photo by author.)

THE SATSUMA ORANGE

There has been such a demand for information relating to the culture and adaptability of the Satsuma orange to Baldwin and Mobile counties in Alabama that the following bulletin has been prepared not only to tell of the work already done but to encourage an industry that promises to bring considerable wealth to the lower section of the State.

As the boll weevil advances in Alabama more attention must be given to the cultivation of crops other than cotton and there is no fruit or vegetable which yields or even promises to yield higher net returns per acre than Satsuma oranges.

Although this orange is the hardiest edible orange in cultivation there is always a possibility of an unusual freeze killing the trees back and for this reason the writer does not advise anyone to invest in Satsuma oranges and nothing else. As explained later, banking the trees above the bud wood, during the winter, insures the orchardist against total loss as trees killed back to the mound will throw out sprouts which will bear again in two seasons. However, the earning capacity of the orchard is practically nil for several years and should such a disaster occur some other crop should be depended upon to tide over such an occasion. Most of the large groves now being planted have the Satsumas interspaced with pecans and this makes an excellent combination. The pecans will eventually overshadow the Satsumas but a considerable income will be realized on the latter before it becomes necessary to remove them.

There are many so-called "native" citrus trees in the lower counties of the State and these would indicate that there is reason to believe that Satsuma orange culture in that section could be made profitable. But aside from this there is evidence on every hand that the orange business has come to stay in Alabama as the writer has visited several bearing orchards which have not only produced profitable crops but their owners are increasing the planting every year.

Note.—The author is indebted to Prof. H. Harold Hume for criticisms and suggestions kindly offered during the preparation of this bulletin.

The Satsuma orange belongs to the Mandarin group of oranges and undoubtedly came originally from China. Some three centuries ago the Satsuma was introduced into Japan and it is from this latter country that China now gets its supply. Some of the Japanese Satsumas enter our American markets.

The Japanese name for the Satsuma is *Oonshiu* and was introduced into Florida by Dr. Geo. Hall in 1876, and later by Mrs. Van Valkenburg in 1878.

There are several bearing Satsuma orange orchards in Baldwin and Mobile counties and one that the writer is particularly familiar with is that of Dr. Scott at Battles Wharf on the eastern shore of Mobile Bay. The trees in this grove range between 2 and 12 years of age and are in a very thrifty condition. A two and one-third acre grove netted Dr. Scott \$1,400.00 in 1909.

The South Orchards Company, which is developing a 2400-acre tract a few miles south of Mobile, has planted approximately 48,000 Satsuma trees among a grove of 16,000 pecan trees. When this tract is completely planted it will be one of the largest combination orchards in the South.

Mr. A. H. Daves, of Irvington, has a grove in bearing in connection with his nursery. The trees are in a strong and vigorous condition.

Dr. A. B. Farnham, of Citronelle, has a small orchard which has proved successful.

Mr. A. B. Gaston, of Springhill; E. T. Molyneux, of Fairhope; Dr. Gaylord, of Barnwell, and J. M. Kroner, of Theodore, all have bearing trees which give every evidence that the Satsuma orange is particularly adapted to the lower section of the State.

Mr. Chas. Schultz, of Marlow, sold \$50.00 worth from 12 trees, besides all the family could pick up for themselves and friends.

Mr. Thomas Brigden, a pioneer horticulturist residing at Prospect in Walker county, recently informed the writer that he experimented with Satsumas some years ago, a friend in Japan having sent him several specimens. One of his trees was

given no protection and was killed by frosts the first season. The second tree was sheltered with pine boughs during the winter. The second season this was killed when the temperature went to 15 degrees below zero. The third tree was planted in a box and placed in a shed during the winter from November 1 to March 1. This third tree produced 8 or 10 crops consisting of 20 to 30 of the most delicious fruit. He stated further, "that with the same care given a tea rose, Satsumas could be handled in a small way even as far north in the State as Prospect." This would indicate that those who take pleasure in handling any sort of plants that need this protection through the winter could grow a few Satsuma oranges which would not only add much interest to their endeavors but would at the same time supply a considerable number of delicious fruits. Should the effort fail a few times the expense and loss of time would be very slight.

POMOLOGICAL DESCRIPTION OF FRUIT.

Form oblate; sections frequently showing through the rind; size variable, $1\frac{7}{8} \times 2\frac{5}{8}$ inches and $2\frac{5}{8} \times 3$ 7-16 inches representing the variation in size; color, orange yellow; base usually slightly creased; calyx, small; apex, scarred with a round brownish spot situated in a broad shallow depression; rind, $\frac{1}{8}$ -inch thick, inclined to be rough; oil cells, large, conspicuous, frequently depressed, though sometimes flush with the surface; flesh coarse grained, deep orange in color; juice sacks short, broad; juice abundant, yellowish orange in color; pulp melting; acidity and sweetness well balanced; flavor sprightly, agreeable; quality excellent; pith open with the sections, frequently separated at the inner edges; generally seedless, though occasionally from one to four seeds are found, top-shaped, broad, plump, not distinctly beaked as in others of the group; season October-November.

Tree thornless, evergreen, and of spreading dwarf habit, branches reclinate, branchlets angled; leaves broad, tapering abruptly toward the apex, petioles scarcely margined. The leaves generally point upward and thus either follow the direction of the branches or are at right angles to them. The smaller

fruits ripen first while the larger ones are later in maturing. In extreme southern climates it does not color well, but remains green or greenish for a considerable time after the juice has acquired its best flavor.*

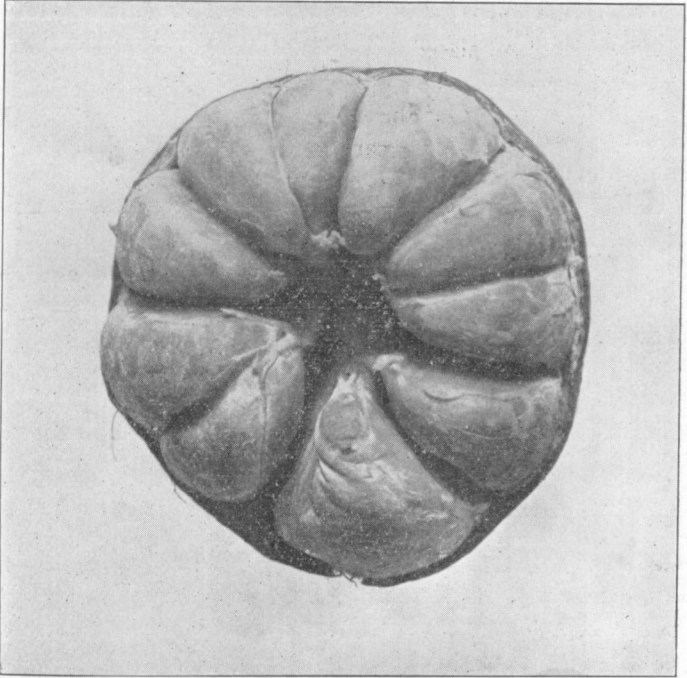


PLATE II. A Satsuma fruit, actual size, showing how readily the sections part. (Photo by author.)

As the trees are thornless the danger of the fruits being punctured during windy weather is eliminated. The plates on pages 163 and 165 show the characteristic form of the trees.

The Satsuma orange is very prolific and comes into bearing when two years old. The writer has counted the fruits on a number of two-year-old trees in Mobile and Baldwin counties which had from 50 to 125 fruits to the tree. The four-year-old trees had from 200 to 400 fruits and 8 to 12 year trees from 1,000 to 1,500 fruits. In Baldwin and Mobile counties the fruits begin to ripen the latter part of September, the main har-

*Description by Prof. H. H. Hume.

vest being made October 8th or 9th. The fruits remaining on the tree even into January retain their excellent flavor but it is not advisable to leave large quantities of the fruit on the trees as late as this as freezing weather will cause serious damage to the fruit. However, this shows that the market season easily ranges from October 1st to January 1st.

The larger Satsumas seem to lack the quality and flavor of the medium sized fruits. Many of these larger fruits are coarse rinded and often warted and contain a large percentage of "rag," indicating that the tree has been supplied with an excess of nitrogen supplied from vegetable sources or that the crop on the tree or sometimes on a single branch of an otherwise well laden tree was scattered which would produce the same effect, the fruits in such cases having an excess food supply.

The more oblate fruits seem to have the best flavor. Variations in the fruit as well as the different stages of ripening will be found upon the same tree. To the person picking Satsumas for the first time, it seems peculiar in removing the rind of a green fruit to find the pulp ripe. Of course, it takes a golden color to sell the fruit and these green fruits are allowed to color up before picking. In extreme southern sections of the gulf coast the coloring comes very late. This is objectionable as the fruits on the trees are apt to be injured by subsequent freezing temperatures and shipments are delayed.

SITE.

There are many factors which make Baldwin and Mobile counties adaptable for the production of Satsuma oranges. Both have the advantage of accessibility to a central shipping point, namely, Mobile, which has direct through railroad lines to the north and east. The principal advantage of the region is the climate. There are no locations in the orange growing regions which are positively safe from the danger of frosts. There are sometimes, numerous locations within a radius of a mile where frosts seldom cause any serious damage while within that same radius might be found spots which are affected by even the slightest frosts. Such factors as elevation, proximity to bodies of water, direction of the wind, wind breaks, cold air drainage, etc., determine the susceptibility to

frost injury even more than latitude. A location either on the side of an elevation or upon its top is preferable to the lower situations.

The prevailing winds in different sections of Mobile and Baldwin counties are variable for the most part. At Daphne, on the eastern shore of Mobile bay, the wind generally comes from the southwest. In determining the position of wind-breaks the older residents of the locality where the orchard is to be planted should be consulted.

The fact that there are many thrifty twelve-year-old trees about Mobile is sufficient proof that the lowest temperatures of the winters during the life of those trees has not been detrimental to them. There is more danger from freezes which follow wind and rain storms than the frosts. Under the subject "methods of protection" the elimination of this danger is discussed. Although Satsumas have not been killed back in the past 12 years there is always a possibility that this may occur and should it, provided the trees have been banked above the bud wood, sprouts will throw out forming new heads which will bear in two or three years. Of course, this may mean a serious, although a temporary loss and the grower of limited means should not be dependent entirely upon his citrus grove but should cultivate other crops in conjunction with it to tide over any period of misfortune. If Satsumas are killed to the ground every twelve years, which is very unlikely to happen, they will still pay splendid dividends on the money invested, where they are cultivated and fertilized properly.

The minimum temperatures from 1897 to 1911 as recorded by the weather bureau station at Mobile follow :

Jan. 28th, 1897.....	18
Jan. 2nd, 1908.....	20
Feb. 13th, 1899.....	1
Feb. 18th, 1900.....	19
Dec. 21st, 1901.....	16
Dec. 27th, 1902.....	23
Feb. 17th, 1903.....	24
Jan, 27th, 1904.....	27
Feb. 14th, 1905.....	15
Dec. 24th, 1906.....	27

Dec. 5th, 1907.....	32
Jan. 24th, 1908.....	28
Dec. 20th, 1909.....	22
Jan. 7th, 1910.....	26
Jan, 5th, 1911.....	18

SOILS.

In Mobile and Baldwin counties the coastal plain rises in gentle swells to about 300 feet above tidewater. There are several types of soil in both these counties and for the most part the surface soil is generally adapted to Satsuma orange culture. More depends upon the nature and proximity of the sub-soil to the surface. Citrus fruits grow on a great diversity of soils although it is noted that a soil containing too much vegetable nitrogen produces abundant wood growth and very poor fruit. This condition may be counteracted by using fertilizers rich in potash. A sandy hammock soil is preferred by the older growers. This soil is found where the timber growth consists or consisted of such trees as magnolia, hickories and oaks. The clay should be within at least 12 to 18 inches of the surface. Bloom will drop if the clay is down too far below the surface. It is impossible to grow Satsumas on alkali soils. High lands are preferable. The soils in Mobile county, for the most part, are a little heavier than those in Baldwin county.

Above every consideration drainage should be thought of. Either the underlying sub-soil should be sufficiently porous to allow moisture to pass down through it or ditches should be made to carry off the excess water.

STOCK FOR SATSUMAS.

Satsuma trees should be budded on *Citrus trifoliata* roots. These are conceded to be the hardiest roots known, and adapt themselves to a wide variation of soils. Prof. Hume has noted an instance where this plant has withstood a temperature of 22 degrees F. below zero without injury. *Citrus trifoliata* is deciduous and this is the only instance we find of the kind among the citrus fruits. As a fruit itself, it is worthless, except for propagating and breeding purposes. There are other stocks used to a considerable extent in the orange industry, but the *Citrus trifoliata* is the only stock that should be used for propagating

Satsuma oranges. Grown on other stock, the Satsuma does not attain such excellent flavor and the trees on other stocks are usually either shy croppers or poor growers. Again, trees grown on *Citrus trifoliata* ripen the fruit several days earlier than other stocks.

Purchasers of Satsuma trees should assure themselves that their trees are budded on *Citrus trifoliata* stock. Mr. Walter T. Swingle, of the Bureau of Plant Industry, has explained the differences between the pith cells of the trifoliata and sour orange. This requires a microscopical examination and where there is any question in the matter specimens of the pith from the main root may be sent either to the Department of Horticulture at Auburn or the Bureau of Plant Industry, Department of Agriculture at Washington, D. C. Groups of the pith cells of the trifoliata orange have thick walls which readily distinguish them from the even and thin walled cells of the sour orange pith. Small portions of the pith can be taken from the root without serious injury to the tree.

The best trees to plant are those with a one or two year top on three or four year old roots. A vigorous, well shaped nursery tree appears below.

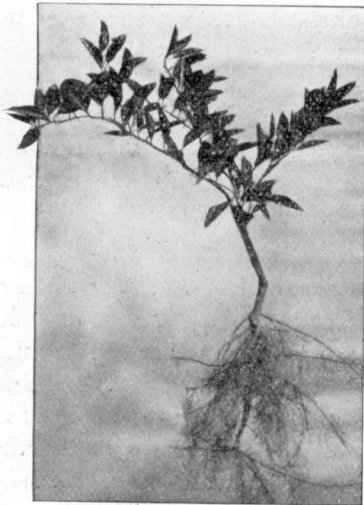


PLATE III. An ideal Satsuma tree from the nursery. One-year top on three-year roots.

The Chinese and Japanese have used *Citrus trifoliata* as a stock for citrus trees for centuries, but it is only recently that the stock has been used for this purpose in this country, and there are yet many points to determine, concerning its adaptability for certain soils and elevations, also its influence in dwarfing trees worked upon it.

San Jose scale attacks *Citrus trifoliata*, but as it does not attack other species of citrus fruits, this is not serious. The stock generally outgrows the top worked upon it, and the more vigorous the top, the more vigorous the stock.

The fact that this stock is not responsive to sudden changes in temperature, especially to those warm spells which generally start activity in other trees during January and February, adds greatly to its value. There is no question but that the stock has a very marked influence on the top growing upon it, and as the Satsuma is the hardiest sweet orange grown, the combination adds, of course, materially to its hardiness.

Satsuma oranges are budded to *Citrus trifoliata* stocks. Buds are inserted in March and April, this being known as *Spring Budding*. When budding is performed in June or July, the term *Summer Budding* is given, and *Dormant Budding* is practiced during September and October. In the latter case the buds remain dormant until the following spring. To protect the dormant buds or the point of union where the budded top has already grown out, soil is banked up on either side of the nursery rows.

The common method of budding is known as T budding but in this case the reversed T is used. The stocks selected are often those resulting from seed planted in the spring, during February, and worked the following spring if of sufficient size. Generally the trifoliata seed is sown in the fall. They sprout in the spring and the following spring they are transplanted and budded in September. The older stocks are better and those two or three years old are most commonly selected. The greatest danger from excessive cold is at the point of union of bud and stock and for this reason care should be taken to bank the soil up above this. Where the point of union is well down toward the crown of the stock this is more easily accomplished.

All leaves and limbs should be removed from the stock near

the ground to facilitate wrapping the inserted bud. A little wood removed with the shield containing the bud does no harm. The bud is pushed gently up under the raised ends of the bark of the stock until all its cut surface has come in contact with the opened surface of the stock. Budding cannot be practiced, unless the bark slips readily.


The buds should be wrapped with a strip of waxed cloth, or raffia beginning slightly below the lower cut, wrapping it tightly around the stock in a spiral manner, so that each new edge overlaps the previous one, and as soon as the vertical cut has been covered, draw the cloth down across this, as it will stick readily to the cloth, and there will be no necessity for tying. The bud is covered with cloth, which is contrary to the method practiced with other fruits.

Considerable attention should be paid to bud selection, as there is great variation in the character of fruits produced on different branches, and where possible, buds from branches bearing the finest fruit should be selected. The demand for Satsuma trees has been so great the past few years, that many nurserymen have been forced to utilize all available bud wood, and in some cases they have not given as close attention to the selection of buds, as is desirable. Trees grown from selected buds will cost more than those not selected but growers will gladly pay the difference in price.

The buds may be unwrapped in from ten to twelve days if the weather has been warm, otherwise they should not be unwrapped for from fifteen to twenty days. Experience will teach the propagator just when the buds should be unwrapped, and an examination of two or three buds will generally indicate the proper time for unwrapping.

Practically all orange trees are dormant budded, banked in the autumn and as soon as danger from frost is past the banks are removed and the tops are cut entirely off close down to the buds. Lopping is not often practiced the tops being entirely removed. If the stocks are of good size the cut surfaces are painted immediately with white lead. If they are small in size painting is not necessary.



PLATE IV. Showing a row of one-year-old Satsumas in the nursery. 

The ideal Satsuma tree is one that is well branched, and in order to produce this sort of tree, it is necessary to cut the tops back when they are two feet high, to induce them to put out more branches. All buds developing below the bud on the stock, should be removed, as they take the strength from the bud wood.

COST OF TREES.

The prices quoted for Satsumas budded on *Citrus trifoliata* stock in a 1911 catalog published by one of the largest southern nurseries growing citrus trees are as follows:

	Each	Per Ten	100	1,000
1 to 2 feet .....	.35	\$3.00	\$27.00	\$240.00
2 to 3 feet .....	.45	4.00	35.00	320.00
3 to 4 feet .....	.55	5.00	45.00	420.00
4 to 5 feet .....	.65	6.00	55.00	520.00
5 to 7 feet .....	.75	7.00		

Many beginners in orange culture are over-anxious to secure bearing trees and consequently neglect to lay the foundation for the orchard properly. As stated above, a crop should have been grown on the land previous to the setting of the trees. Velvet beans, or cow peas are excellent crops to be turned under to supply humus and add nitrogen to the soil. Such a crop saves on the fertilizer bill considerably and at the same time puts the soil in the proper condition for tree planting.

PREPARATION OF THE LAND.

Complete clearing is far more preferable than partial clearing. All standing timber except portions which may be utilized for wind-breaks should be cut and the stumps removed. A stump puller, the use of dynamite or burning out the stumps are methods generally practiced. All this work should be done the winter previous to the planting. One method commonly practiced is to plow the land 4 inches deep during the winter before planting and later plowing again about 10 inches deep. This method allows the humus to remain near enough to the surface to promote nitrification and the deep plowing mixes the decomposed vegetable matter thoroughly with the soil.

If the first plowing is deep a disc plow should be used, as this turns the soil on edge allowing the vegetable matter to decompose without souring. This method also prevents a deep layer of clay being thrown up to cover the humus. Shallow plowing can then follow in the spring when such crops as cabbage, Irish and sweet potatoes, peas or beans can be planted followed by late Irish potatoes. Good clean culture the first year should be practiced on new land to put it in shape for the orange grove.

Where the sub-soil consists of rather stiff clay a sub-soil plow should be used along the proposed tree rows to allow the roots to easily push their way into the moisture retentive soil. After plowing the harrow should be used and this followed by a drag consisting of overlapping planks which will put the surface in excellent condition. This thorough preparation aids the stakers and hole diggers.

SYSTEMS OF PLANTING.

There are several different methods of laying off a grove consisting of the square, triangular, hexagonal and quincux systems. The hexagonal (six sided) system, or the square system, should be used unless the Satsumas are planted between pecans. In the latter case the square or rectilinear method should be used.

Double plantings may be made such as placing a peach tree in each square of orange trees. The peach tree serving its usefulness in 5 or 6 years is cut out.

INTER-CROPPING.

Many crops can be grown between the tree rows until they seriously interfere with the best development of the Satsumas. Some growers have been raising vegetables between the rows the first few years with much profit.

Laying out. A stout wire is often used, which is long enough to reach along one side of the field. This wire should have rings at 16-foot intervals or pieces of wire soldered to it at these intervals. Two sixteen-foot wires with rings attached to either end are also used. Having placed stakes at the intervals along the wire establishing the locations of the first tree row, take the sixteen-foot wires placing one end of one on stake No. 1 and the end of the other on stake No. 2, then bring the other ends together and at the place they meet place a stake for the beginning of row No. 2. This is repeated, next placing the first 16-foot wire on stake No. 3, bringing it to meet the wire on No. 2, etc., continuing until row 2 has been staked off. Row 3 is similarly determined.

TIME FOR PLANTING.

There are many planters who advocate November planting of Satsumas, while others contend that the trees should be planted in February. If the soil is moist in February or March, providing the trees are freshly dug, planting at this time may be successful. In fact, there have been successful plantings of the Satsumas at various times throughout the winter but all things considered, November or December planting is preferable. There is, of course, the danger of frosts injuring young trees, but this is obviated by banking

clean earth, free from pieces of weeds or trash up several inches about the bud wood, this earth to be pulled away in the spring, after danger from frosts has passed.

Transplanting can be done in July or August if the trees have been selected and there is plenty of moisture in the ground, but there is little necessity for moving trees at this season.

PLANTING.

The roots of the *Citrus trifoliata*, upon which the Satsumas have been budded are very fibrous and delicate, and great care must be exercised in the handling of the trees after they have been removed from the nursery. These delicate roots should not be exposed to wind or sunlight, and even when the trees are taken to the field, the roots should be kept covered, and a sufficient number of holes should be prepared, so that there will be no delay in getting the unpacked trees into the ground.

The different States which have nursery inspection laws, require trees to be entirely defoliated, and fumigated before they are shipped, and this so-called "goose-picking" prevents the distribution of the insect known as White Fly, which is a menace to the citrus industry.

Most of the nurserymen have been pruning the roots before sending the trees out, but the business has grown so rapidly that they have been giving up this practice. It would be much better for the nurserymen to attend to this, as the planters are very apt to pay little attention to either top or root pruning.

Satsuma trees are packed in bales by the nurseryman in lots of 100 to 500, depending on their size. Boxes are used for lots of 2,000 or over. It generally pays to have the trees shipped from the grower by express as delays in transit are often disastrous. As the roots dry out very rapidly the nurserymen should be required to "puddle" them before packing and when the trees are ready for planting the "caked" earth should be washed off.

The holes should not be prepared until everything is ready for planting, to conserve the moisture; they should be commodious, and in planting the trees the fibrous roots should be spread out very carefully, as wherever they are allowed to become matted, they are apt to ferment and rot. Mr. E. T.

Molyneux, of Fairhope, Ala., has had considerable experience in planting Satsumas, and he has one man throw the dirt in about the roots, while another uses a watering pot to settle the dirt as it is thrown in, until the hole is nearly full, and then the remaining portion of the hole is simply filled with loose soil, which gradually settles. In planting trees, particularly oranges, the planter is generally too hasty, and with the exception of poorly prepared land, this is the cause of the frequent losses in new plantings.

Practically all the root system for Satsumas should remain intact and the pruning should consist of the removal of broken and bruised portions, making smooth cuts above these, as these smooth cuts will callous rapidly, and from these callouses, new roots will be rapidly produced. Wherever the roots become dry, the dry portions should be removed. The trees should be planted at the same depth that they were in the nursery rows, and to protect the newly planted trees from the hot rays of the sun, the trunks are often wrapped in paper or straw, or covered with whitewash. The top, if consisting of a single stem, should be cut back about two feet above the ground, and if there are any branches leading from this, these should be cut back to spurs, having two or three buds on them.

The top soil should always be saved to place down around the roots and where this is very poor use about one pound of a commercial fertilizer rich in nitrogen well mixed with it placing this in the hole at least six inches below and six inches further out than the roots reach. Some growers have used a dressing of rotted stable manure as the only source of fertilizer until the trees come into bearing, care being taken not to have this come in contact with the roots or body of the tree. This practice is dangerous, however, as manure is not apt to be well rotted when it appears to be. Some nurserymen have lost many trees by using supposedly rotted manure. A pound of bone meal added to the manure is still more beneficial. When the trees have come into bearing fertilization with stable manure or sources of vegetable nitrogen should cease as this tends to produce excessive wood growth at the expense of fruit. Again the fruit resulting from such fertilization tends to be oversized and "warty" and the flavor is very poor.

FERTILIZATION.

No fertilizer should be used at the time of planting unless the soil is very poor. The fall after planting use stable manure or scrapings from the barnyard and dig it in about the trees, not working too close to the trunk. When the trees are bearing well and growing vigorously, fertilize well, with about five pounds per tree of the following formula on land with a moderately heavy clay sub-soil, applying it about the latter part of March:

100 lbs. sulphate or muriate of potash.

950 lbs. cotton seed meal.

950 lbs. 14% acid phosphate.

2,000 lbs. Total.

The above is an 8-3-3 goods.

For land with sandy clay sub-soil use an 8-2-9 formula consisting of the following:

1,000 lbs. acid phosphate.

200 lbs. cotton seed meal.

36 lbs. nitrate of soda.

360 lbs. muriate of potash.

404 lbs. soil.

2,000 lbs. total.

When the sub-soil is light it will require an 8-4-12 formula.

Mr. A. H. Daves at Irvington, Ala., who is growing Satsuma oranges successfully, has been applying 400 pounds of bone meal and 200 pounds of potash for his half acre orchard, making the application the latter part of April or first of May after the bloom has set.

CULTIVATION.

In most sections of Mobile and Baldwin counties it is advisable to bank the trees with clear earth up several inches above the bud to protect the trees from possible freezes. Cultivation should not commence until danger of such freezes are past when the banks can be removed.

For the first two years cultivation should consist of using a two-mule plow and harrow, several shovelfuls of stable

manure having been scattered close enough to the trees to benefit them but not too close to the trunk of the tree. Two weeks after plowing, cow peas may be planted in rows between the tree rows. In the middle of the tree rows next the water furrow a row of velvet beans can be planted. The cow pea vines will be dried up in July and at this time the velvet beans will have reached the tree rows. There is seldom trouble from the beans climbing the trees as they have attained their maximum growth by the time they have covered the tree rows. This system of planting cover crops will conserve moisture and time spent in cultivation. After frosts have killed the beans they may be turned under.



PLATE V. One of Dr. Scott's two-year-old Satsuma trees.

The same method may be practiced the third year using of course more stable manure and substituting the lighter one-mule plow as the spring plowing this third year should be comparatively light. The disc harrow should follow this light plowing to level the ground.

From the third year on light cultivation should be practiced. Provided there is still much vegetable material scattered over the surface of the grove which has remained from the previous fall it will be necessary to use a cut-away harrow for the first cultivation. This first harrowing can be rather deep provided the new roots have not come too close to the surface. After this first harrowing it is merely necessary to maintain a mulch of pulverized soil over the orchard to a depth of not over an inch or two. This can be accomplished by using a light weeder if the preliminary cultivation has been sufficient.

Where cow peas are planted between the trees in the grove they should receive a liberal application of fertilizer using 200 pounds of acid phosphate in the drill before planting the peas. The cow peas often pay for a considerable proportion of the cultivating and fertilizer bills. Where the peas are planted the middle of January they can be harvested the latter part of April and at this time they bring good prices in the market. The pea rows should not be planted closer than six feet from the spread of the tree branches and their cultivation should be discontinued at any time when they interfere with the growth of the trees.

It will require a light cultivation about every ten days much of course depending upon the rains, to keep the grove in perfect tilth. This should be continued until about the first of September. Later cultivation than this may prove disastrous owing to the fact that the trees respond readily to cultivation and it is the object at this season to allow the wood to harden and mature in preparation for winter. All vegetable growth on the ground should be turned under by December first. From observations made the past winter it has been clearly shown that trees should not be forced in view of their susceptibility to frost injury. When the trees are in a thoroughly dormant condition there is little danger from excessive cold weather and the grower should aim to maintain that dormant condition in his trees through the winter.

PRUNING.

If the trees have been properly pruned at the time of planting there is little need for subsequent pruning.

A low headed tree is preferable and by this is meant one which does not branch more than 12 to 18 inches above the ground. Whenever cuts are made they should be made smooth and when branches are removed which are one-half inch or more in diameter the cut faces should be painted with white lead.



PLATE VI. A six-year-old Satsuma tree.

Since the big freeze of '98 practically every grower has headed his trees much lower than previous to the freeze. The foliage being nearer the ground serves as a considerable protection to the trunks of the trees. It is much easier to gather the fruit from the low headed trees. Such trees are also better able to withstand high winds. In case it should become necessary to use orchard heaters or build fires to protect the trees during a freeze it will be found an advantage to

have the trees headed low as there is less air circulation in such a grove. Staking the heavily laden branches is not always necessary. The lower branches lying upon the ground will support those above them and there is practically little damage done to the fruit resting upon the ground. Staking or "propping" is rather expensive. Where the owner has but a few trees it might be well to prop the branches.

PROTECTION AGAINST COLD.

It is advisable to bank the trees through the winter as before mentioned. This had best be done from the middle of November to the middle of December. Most of the coldest weather occurs through January and February but there has been one instance when the temperature has fallen to 16 degrees F. as early as December 21st. Care should be taken not to bank the trees too high as this may injure them. It is only essential that a sufficient amount of bud-wood be protected. The soil used in banking the trees should not contain decaying vegetable matter as this may injure the bark where it comes in contact with it and it may foster the work of wood-lice. Winter rains will cause the banks about the trees to settle and it may be necessary to go over the trees a second time in the course of a few weeks.

When the temperature reaches 27 degrees and there is fruit on the trees wood fires or the orchard heaters should be started. There is also danger with the temperature at 30 degrees when the trees are opening their fruit buds. The older trees withstand low temperatures much better than the younger trees.

There are a number of good orchard heaters on the market the average price being \$30.00 per hundred. Much depends on their capacity. The heaters should hold not less than two gallons of fuel oil. The greatest damage is apt to be done between 2 a. m. and 6 a. m. but the trouble may start even before this. Fuel oil should be used and this can be secured in carload lots at 2 1-2 cents per gallon. This oil should be purchased on a co-operative basis, that is, several growers should combine in ordering and thus materially reduce the price they would necessarily pay on small quantities of oil. This oil can be stored in galvanized iron tanks or in cemented

cisterns provided the walls of the latter have been coated with a layer of asphalt paint to prevent leakage.

Although the orchard heater may never be called upon to save an orange orchard or crop it is always prudent to be prepared. The heaters have lately come into prominence among the vegetable growers and where the latter are grown in large quantities for the northern markets in addition to the culture of oranges, the value of the heaters is much more augmented.

MARKETING.

The earlier the period of ripening of the Satsuma the more important, from a commercial standpoint as at that time there is practically no competition from either the California or Florida oranges. Where the Satsuma is known, even with this competition, there would hardly be a chance of crowding out the Satsuma, as among a great many people it is preferred even to the Florida and California orange. The Texas growers are somewhat concerned regarding a future market for the Satsumas coming from the large groves which have been planted there recently, but the writer believes that first-class Satsumas, well graded and well packed and placed in the right markets will always bring profitable returns for the growers. The fruit packs and ships well and will not deteriorate in two or three weeks from the time of picking.

As the production of Satsuma oranges increases it will be necessary for the fruits to be cured as the Florida and California oranges are treated before shipping them. In Texas they are curing their Satsumas in large curing houses. The fruits are gathered in half bushel boxes which are 22 inches wide, 40 inches long and 12 inches high. These have a partition in them and as they are brought into the curing house they are placed in tiers. At the duration of 4 to 6 days early in the season or 2 to 5 days later in the season the fruits are graded and packed. Treated in this way the fruits will keep a considerable time in the open market.

The "special" market uses up the present supply very rapidly, and as more people learn the value of the orange and with constant shipments from the growers there is little doubt that the question of keeping quality will not concern the grow-

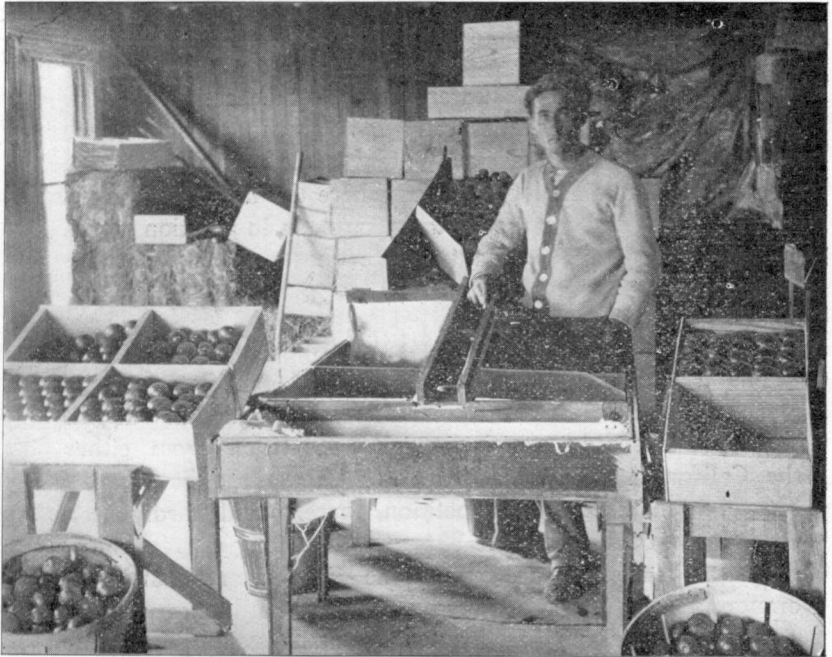


PLATE VII. Interior of a small grading and packing shed.

ers for some time. Chicago people have become very fond of the Satsuma and many of the southern growers are shipping their oranges into that market. At present the cities of Mobile and New Orleans consume most of the oranges grown along the gulf counties of Alabama, Mississippi and Louisiana. Most of the fruit is packed in barrels which contain from 700 to 900 fruits bringing from \$16 to \$18 per barrel. Shipping by the barrel is much cheaper for the grower, and will do very well at present for the local trade, but for northern shipments the half-crate or strap is used. Some of the growers are paying considerable attention to proper packing and grading, and this, of course, is to be commended and will be necessary as the industry increases. These straps contain on the average about 240 fruits and bring from \$4.25 to \$4.50 in the wholesale market. Dr. Scott, of Battles Wharf, has been selling his fruit by the hundred at from \$1.75 to \$2.00, the fruits bring from 10 cents a dozen up to 35 cents a dozen retail, depending on their size and quality. The fruit runs from $1\frac{1}{2}$ to $3\frac{1}{2}$ inches in diameter.

DISEASES AND INSECTS.

Although there have been very few reports from Satsuma growers in Alabama concerning fungus or insect troubles the trees have been attacked by both in other sections and there is the probability that with the increase in plantings more instances will be noted of these troubles. Prof. Harold Hume in his book entitled "Citrus Fruits and Their Culture" has given much valuable information concerning the diseases and insects attacking citrus fruits and abstracts from portions of his descriptions follow:

Citrus stock is resistant to a large degree to the disease known as Foot Rot. This trouble is confined to the crown and main roots of trees extending about a foot above the ground and to some distance down along the roots. An exudation of gum indicates the trouble. When the tree is attacked the leaves turn yellow.

Scab.—This trouble has been found on Satsumas and when they are attacked by it the fruits become distorted and warty, corky elevations cover the surface and give it a roughened appearance. Often the leaves are drawn out of shape. The disease is caused by a species of *Cladosporium citri*.*

The disease can be controlled by spraying the trees with ammoniacal solution of copper carbonate. This solution is not apt to injure the foliage. The formula is as follows:

Copper carbonate, 5 ounces.

Strong ammonia (26 per cent.) 3 pints.

Water, 50 gallons.

Reduce the copper carbonate to a thin paste with water; slowly add the ammonia. Finally add the fifty gallons of water.

Sooty mold.—Practically all citrus growers are familiar with this trouble. Where present the leaves, fruits and twigs are covered with a black sooty coating. Wherever scale and associated insects which exude honey-dew are present this sooty mold will be found. This fungus lives on the honey dew and when it follows the attacks of the White Fly (*Aleyrodes citri*) which attack the under sides of the leaves the damage is considerable.

The leaf surfaces being covered with the fungus are unable

*Recently determined by Fawcett.

to perform their functions and create an unhealthy condition of the trees. The stem end of the fruits are generally covered with the fungus and necessitate brushing of such fruit before placing it upon the market. This treatment is apt to be detrimental to the fruit and adds considerably to the cost of harvesting and marketing.

To eradicate the trouble the insects must be destroyed which secrete the honey-dew and this matter is treated under the subject of Insects.

INSECTS

White Fly (*Aleyrodes citri* Riley and Howard.)

During warm weather egg laying commences within thirty hours after the adults appear. The eggs are deposited upon the under surface of the leaves, generally on new shoots. Hume has noted 20,000 eggs deposited upon a single leaf. The eggs hatch in from three to twenty days much depending upon the weather. The young larvae being whitish green and translucent are rather difficult to discern. There are four larval stages before the pupal stage is reached.

The adult female is a little over 1.4 mm. in length and her wing expanse is about twice the length of the body (1-10 of an inch). These wings are colorless when the female is first hatched but become covered with a white wax within a few hours. The male resembles the female.

Treatment.—All nursery stock should be completely defoliated before being planted. Trees affected should be either fumigated or sprayed with hydrocyanic acid gas with Good's Potash Whale Oil Soap or Schnarr's Insecticide during the pupal stage of the insect. The spray mixtures mentioned are recommended for small growers.

Fumigation methods have been discussed at length in several Department of Agriculture Bulletins, the latest contribution to the subject being Bureau of Entomology Bulletin No. 76 which can be obtained by writing Secretary Wilson or addressing the Department of Entomology at Washington, D. C.

In a recent article in the Florida Grower, Mr. W. W. Yothers and Mr. S. S. Crossman have discussed some results of their work with miscible oils for controlling the White

Fly. Four formulas are given and a summary of their results follow :

FORMULA No. I.

Caustic potash whale oil soap.....	1½ gals.
Crude oil (not distillate oil) 24 degrees Baume..	3 gals.
Water to emulsify about.....	1½ gals.
This will make about 200 gallons of the spray material containing 1½% of oil. Cost about 63 cents.	

FORMULA No. II.

Caustic potash whale oil soap.....	2 gals.
Distillate oil (gas oil) 30 degrees Baume.....	4 gals.
Water to emulsify about	2 gals.
This will make 200 gallons of spray material containing 25% of oil. Cost about 84 cents.	

FORMULA No. III.

Caustic potash whale oil soap.....	2 gals.
Paraffine oil (Diamond paraffine oil) 28 degrees Baume	3 gals.
Water	1 gal.
This will make 200 gallons of spray material containing 1½% of miscible oil. Cost about \$1.00.	

FORMULA No. IV.

Caustic Potash whale oil soap.....	2 gals.
Paraffine oil (Junior Red Engine oil) 2 degrees Baume	3 gals.
Water	1 gal.
This will make 200 gallons of spray material, containing ½% of oil. Cost about \$1.05.	

Preparation.—Care should be taken to add the oil to the soap gradually while it is being stirred. Satisfactory results cannot be obtained by adding the oil to the soap or the soap to the oil too suddenly. This stirring should continue for about a minute, when the water may be added. To determine whether a perfect emulsion is being obtained, put a little of the mixture in a glass of water. The presence of free oil on the surface will indicate that more stirring is necessary. Where a pump is used in mixing, one-half the amount of soap is necessary.

Formula Nos. I. and II. do not loosen the sooty mold to any great extent and neither have they the stable qualities which, according to our ideas, will make them valuable to withstand the summer rains. We recommend them for use in winter and where the immediate loosening of the sooty mold is not desired. Formula Nos. III. and IV. loosened the sooty mold perfectly and have the stable qualities which we hope will make them valuable for summer use. Whale oil soap No. 312 to 15 Lbs.

According to the authors and Dr. E. A. Back, April is perhaps the best time to spray. For summer use formulas III and IV should be diluted to make 300 gallons.

“Diamond Paraffine and Junior Engine Oil” are trade names. The former is used for slow moving bearings and costs 13 cents per gallon in barrel lots. The latter is used

for fast moving bearings and costs about 14 cents per gallon.

"At present we are unable to see any difference in the insecticidal qualities of the two oils, so the other uses to which they may be put will assist each grower to decide for himself which to buy."

"Schnarr's Insecticide" sold by J. Schnarr & Co., of Orlando, Fla., has given good results for the control of White Fly. This sells for 40 cents per gallon in 50 gallon lots. The manufacturers recommend 50 gallons of the insecticide for 2,000 gallons of spray.

Soft Scale (*Lecanium hesperidum*. Linn.)

This scale is known also as the turtle-back scale or brown scale, has been reported by many growers in Alabama this fall (1911). In some cases the apprehension of danger from the soft scale has let to some growers cutting down many of their trees. The older growers have learned that natural enemies, such as parasites and lady bugs have controlled the insect sufficiently to cause no serious alarm. In fact, as Hume has written the author "it is probably the least noxious of all citrus scales." One thorough spraying with whale oil soap will destroy the insects.

This insect changes its color as it develops from a transparent yellow in the young, changing to a brown in the adult. The latter is 3 or 4 mms. long (.12 to .16 inches), is turtle shaped, broadly oval, and swollen, and has a flattened rim encircling the scale. The female insect during its last stages becomes merely a cap filled with young. The young are thin and flat and scarcely discernible on the leaves or twigs. The insects starve unless they can reach the young tender bark or leaves of the new growth. As they have no true scales but rather a toughened skin they are soon exterminated by the attacks of natural enemies or by spraying.

The Purple Scale (*Lepidosaphes beckii*.)

This scale attacks Satsumas and resembles the "Oyster Shell Bark Louse" which has given the apple growers so much trouble. The eggs are very small and white. The young larvae are about one-tenth of an inch long. They soon settle on the bark or along the mid rib of the leaves. When the female scale insect is nine weeks old it deposits eggs of the second brood, the young from these eggs emerging from

beneath the scale in about a week. The greatest activity among the young is about the latter part of March; in June or July; and in September or October according to Hume.

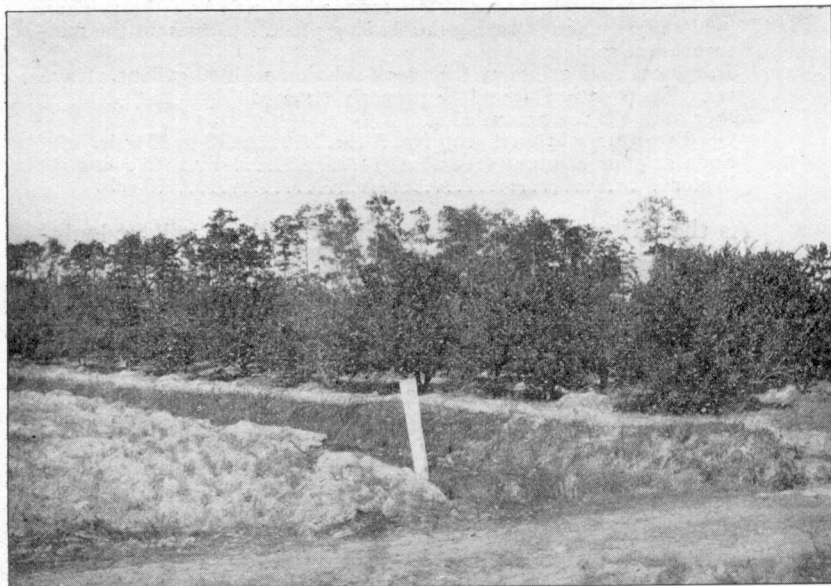


PLATE VIII. A portion of the Glen St. Mary Nursery Company's Satsuma orchard, one of the oldest in the South.

Treatment.—Good's Caustic Potash:

Whale oil soap No. 3.....	12 to 15	lbs.
Water	50	gals.

or

Kerosene oil	2	gals.
Soft whale oil soap	1	quart.

or

Chipped hard soap	½ lb.
Water	1 gal.

Preparation.—Dissolve the soap in the gallon of water which has been brought to the boiling point and while still boiling pour it out into another vessel away from the fire. The kerosene may now be added and the best way to emulsify the materials is to pour it all into a force pump and force it back into itself for several minutes. The lost water should be added so that there will be 4¼ gallons.

To Use in the Winter Months.—Add 10 gallons of water to each gallon of the solution. For use during the summer add 15 gallons of water to each gallon of the solution. Do not use kerosene emulsion on the trees when defoliated.

Orange Rust Mites.—The Six Spotted Mite and the Purple Mite or Red Spider will undoubtedly be a source of trouble as the Satsuma plantings increase. Prof. Hume recommends the following formulas for these pests:

SODA-SULPHUR SOLUTION

Sulphur	20 lbs.
Caustic soda (98%)	10 lbs.
Water	20 gals.

Preparation.—Mix the sulphur to a medium thick paste with cold water in a barrel, then add the soda, which will boil the sulphur. Add sufficient water during this boiling process to prevent the mixture burning.

Dilute one-half gallon of this stock solution with 40 gallons of water. The solution should be properly strained.

Another formula recommended is:

Good's potash whale oil soap No. 3	12 to 15 gals.
Soda sulphur solution (see above)	1 to 2 quarts
Water	50 gals.

As the Satsuma orange groves increase there will undoubtedly be more attention given to the various fungii and insects which attack the trees and fruit. Growers should report any such troubles to the Department of Horticulture or Department of Entomology at Auburn that they may be identified and remedies suggested. The writer will be glad to learn the names of all growers, also the number of trees in their respective orchards, and any other data which will help to increase our knowledge of a very promising industry.

Co-operative experiments have already been undertaken by the Department of Horticulture at Auburn with Satsuma growing in Alabama and it is the desire of the Department to extend this work.

The author suggests that the Satsuma growers organize so that larger quantities of fruit may be shipped than is now the case with individual growers. Again it will be necessary to standardize the grading and packing, a problem to be handled by an organization. Such an organization will do much to disseminate knowledge concerning the culture of the Satsuma. Again a more concerted action can be taken when it becomes necessary to fight insect or fungus pests. Small growers co-operating can afford to buy better spray pumps and in purchasing chemicals for a number of growers the prices are less than where expressed to individuals.

Sample boxes of graded Satsumas should be expressed to the larger cities where they should be exhibited to acquaint the public with them. If a growers' organization would handle this matter it would be a very short time before an appreciative market would be developed.