

Issued October 24, 1907.

U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN 307.

ROSELLE: ITS CULTURE AND USES.

BY

P. J. WESTER,

Special Agent, Bureau of Plant Industry.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.

1907.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., August 4, 1907.

SIR: I have the honor to transmit herewith the manuscript of a paper entitled "Roselle: Its Culture and Uses," by P. J. Wester, Special Agent at our Subtropical Laboratory and Garden, Miami, Fla., and to recommend that it be published as a Farmers' Bulletin.

The roselle plant is adapted for culture in the tropical and subtropical regions of the United States, and should be especially valuable in southern California, Florida, the tropical islands of the United States, and in the Canal Zone. It is used in the South very much as the cranberry is used in the North, and is especially valuable for the making of jellies.

In the preparation of this bulletin the writer has received many valuable suggestions and considerable aid from Dr. Ernst A. Bessey, Pathologist in Charge of the Subtropical Laboratory and Garden, Miami, Fla. Dr. L. O. Howard, Chief of the Bureau of Entomology, identified the soft scale and yellow aphid, and Dr. H. W. Wiley, Chief of the Bureau of Chemistry, made the analyses of the roselle and the cranberry.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

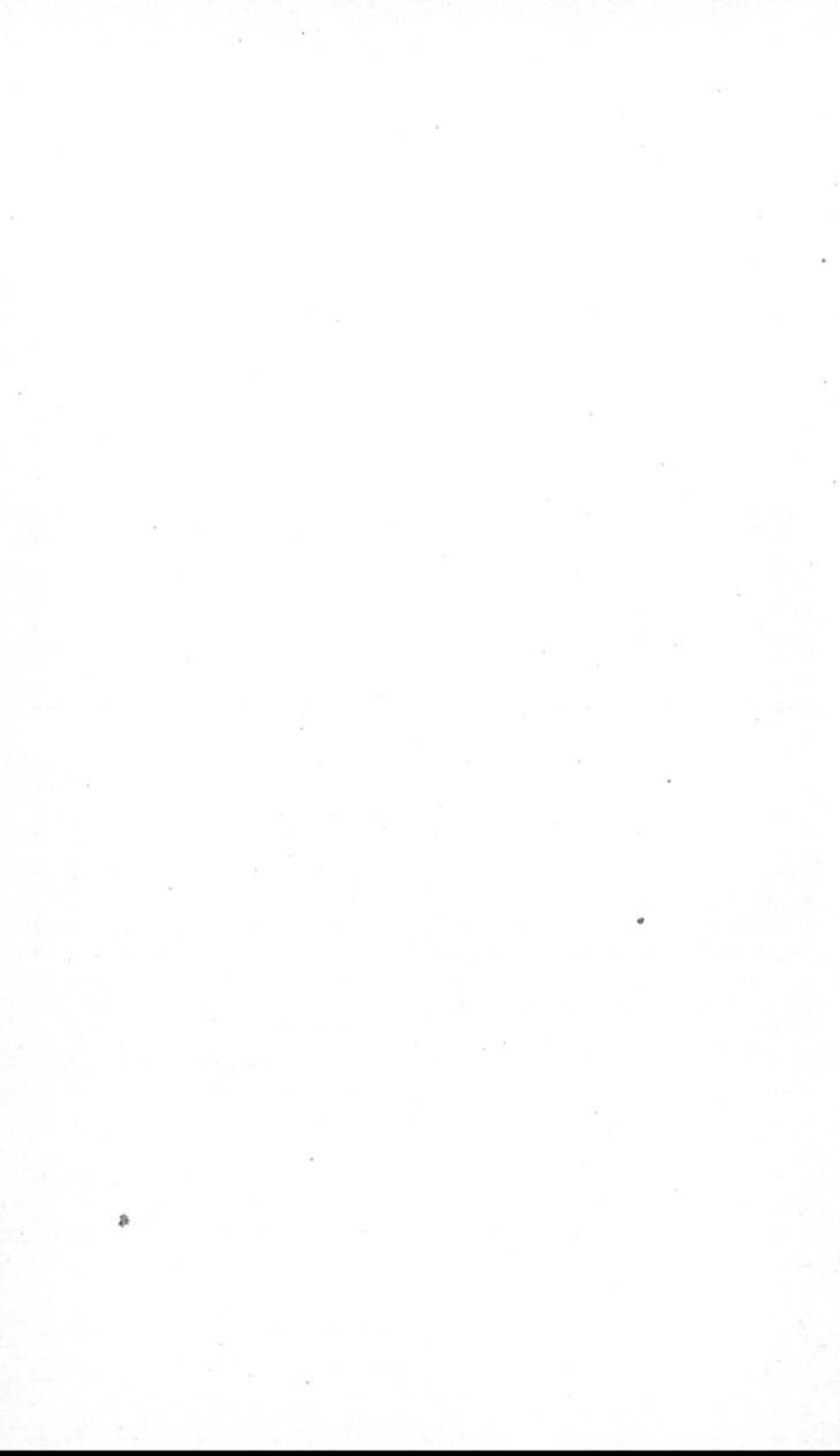
HON. JAMES WILSON,
Secretary of Agriculture.

CONTENTS.

	Page.
Introduction.....	5
History and geographical distribution of the roselle.....	6
Botanical characters and relationships.....	7
Varieties.....	8
Cultivation and fertilization.....	10
Yield.....	12
Harvesting and marketing the calyces.....	12
Composition and uses of the fruit.....	13
Use of the plant for fiber.....	14
Breeding.....	14
Fungous diseases and insect enemies.....	16
Summary.....	16

ILLUSTRATIONS.

	Page.
FIG. 1. Roselle plant.....	8
2. Branch of the roselle plant, showing blossoms.....	9
3. Mature calyces of the ordinary roselle, somewhat affected by mildew ..	9
4. Mature calyces of the Victor roselle, somewhat affected by mildew	10
5. Mature calyces of the Victor roselle.....	10
6. Calyces of the roselle prepared for cooking by removal of seed pods ...	13



ROSELLE: ITS CULTURE AND USES.

INTRODUCTION.

Fruits and economic plants indigenous to the Tropics are now as never before attracting the attention of the people of the United States. Some, such as the avocado and the guava, are natives of the Western Hemisphere; others, like the roselle, are introductions from the Old World.

A strictly tropical plant, the roselle is very sensitive to frosts. This, together with its peculiar habit of blooming late in October regardless of the time when the seed is planted, has restricted the cultivation of the roselle to tropical and subtropical regions. Its distribution, for this reason, has not been so general nor has the plant become so widely known as introduced plants indigenous to the Temperate Zone. It is, however, only rational to assume that this objectionable feature could be overcome were persistent efforts made with that end in view and that the roselle, like so many other cultivated plants which have yielded to changed climatic conditions, would adapt itself to the shorter summers of a higher latitude.

Introduced several years ago into California and Florida, the roselle deserves a wider cultivation than it now enjoys and should prove a valuable acquisition to the tropical islands of the United States and to the Canal Zone. The cultivation of the roselle is so simple and its requirements so few that in the Tropics and Subtropics it should be an indispensable plant in the garden of every family. This fact, in view of its peculiar adaptability for jelly making, should cause the roselle to become a plant of considerable importance in the United States at no distant date. The roselle is probably the only plant in cultivation in which the part utilized for food^a is the calyx. Of rather low nutritive value, the thickened calyx possesses excellent qualities for the manufacture of jelly and allied products. Preparations made from it closely resemble in color and flavor those made from the cranberry. It is rather singular that its season of maturity also coincides with that of the cranberry.

In Queensland, where the culture of the roselle has in recent years assumed considerable proportions, the fruit is utilized largely in the manufacture of jam. In the United States its principal use would probably be as a substitute for cranberries in the household and in the manufacture of jelly.

^a For analyses showing the food value of the calyx and pod of the roselle, see Farmers' Bulletin 293, page 14.

HISTORY AND GEOGRAPHICAL DISTRIBUTION OF THE ROSELLE.

The almost total absence of literature relative to the roselle until the last two decades and the lack of cultural varieties would seem to indicate that the culture of this plant is of comparatively recent origin. De Candolle, in his "Origin of Cultivated Plants," 1885, does not mention it.

The writer has examined many of the older works on Indian agriculture without finding more than one referring to the roselle. This work^a is devoted to fiber-producing plants, which shows that roselle was early cultivated for its fiber. The author says, speaking of roselle, okra, and *Hibiscus abelmoschus*: "The dietical use of these species has been mentioned in order to show that if cultivated on account of their fiber they would also be useful for other purposes"; and it would seem from this quotation that the various uses of the roselle were not generally known at that time. For more than thirty-five years subsequent writers on Indian agriculture maintain absolute silence on the subject, and Duthie^b mentions the plant only incidentally. Woodrow^c speaks of its utility for jelly making. In India the plant has been grown chiefly for its fiber. It has apparently not attained much importance for culinary purposes.

The writer has been unable to obtain any data relative to the introduction of the roselle into the British colonies in Australia, where its cultivation evidently is more extensive than anywhere else in the world, as, according to Semler,^d two large preserving factories utilizing the roselle were in operation in Queensland in 1892. Shinn^e refers to roselle jam as being shipped to Europe in large quantities.

The Queensland Agricultural Journal, volume 6, page 371, published in 1900, contains the longest treatise on the roselle that has come to the attention of the writer. Its brevity, it being less than five pages in length and containing no references to any previous literature, presupposes the recent development of the industry there. In Queensland the calyces are mainly utilized in the manufacture of jam, but are also, according to the article cited, well adapted for pickles, while the writer also calls attention to the fact that the roselle can be propagated from cuttings and that such plants bear fruit when earlier and more vigorous seedlings bear little or none. The seed is sown in October in Queensland.

The roselle is hardly mentioned in the horticultural literature of the West Indies, indicating that it is an object of indifference there. It was probably introduced from India before 1855, as Royle^a in a work published that year says that it is there called "red sorrel."

^a Royle, J. F. Fibrous Plants of India, 1855, p. 260.

^b Duthie, J. F. Field and Garden Crops of Northwestern Provinces and Oudh, 1893.

^c Woodrow, M. Gardening in India, 1899, p. 183.

^d Semler, H. Die Tropische Agricultur, 1892, p. 391.

^e Report of the California Agricultural Experiment Station, 1896-97, p. 382.

In Hawaii the roselle, although introduced long ago, has not received much attention.

Eleven or twelve years ago a Mr. Neustadt, of San Francisco, imported seed from Queensland, and the plant was tested and seed subsequently distributed in California by the agricultural experiment station of that State. The plant received much favorable comment there from those who tested it at that time.^a Later literature is silent on the subject.

The name in Florida, "Jamaica sorrel," is evidently an indication that the plant was introduced from Jamaica—at what date the writer has been unable to ascertain—but it was probably not extensively grown in Florida before 1887, as P. W. Reasoner^b does not refer to it. Harcourt^c does not speak of it.

In Florida, as in California, those who have tried the roselle have nothing but praise for the plant, and considerable interest in it is manifest, but its culture on a large scale has not yet, to the knowledge of the writer, been undertaken by anyone.

The assumption by Royle^d that the name roselle is a corruption of the French word "oseille" (the equivalent of the English "sorrel") seems very probable. In the evolutionary stages the name has at different times been spelled "rouselle," "rozelle," and "rosella."

BOTANICAL CHARACTERS AND RELATIONSHIPS.

Roselle (*Hibiscus sabdariffa* L.), or Jamaica sorrel, as it is sometimes called, is an annual from the Tropics of the Old World belonging to the large family Malvaceæ. Itself furnishing the roselle fiber of commerce, it is closely related to several genera containing fiber-producing plants: *Sida*, *Malva*, *Althea*, and *Lavatera*. Its most important relative is cotton (*Gossypium* sp.). Of vegetables, okra (*Hibiscus esculentus* L.) is related to the roselle. Among related ornamental plants may be mentioned species of *Abutilon*, *Hibiscus*, *Althea*, and *Malva*.

The habit of the roselle (fig. 1) is similar to that of the cotton plant; the stem is reddish, branching profusely. As usually planted—that is, in February and March—the roselle attains a height of from 5 to 7 feet. The leaves on the young plants are entire; as the plant increases in size the leaves change to palmately five parted; later, the leaves in whose axils the flowers are borne are three parted. The large, almost sessile yellow flowers, each with a red eye, are usually borne singly in the axils of the leaves (fig. 2). They fade before the day is past and the subsequent enlargement of the calyces is then

^a Report of the California Agricultural Experiment Station, 1897-98, p. 236.

^b Bul. 1, Division of Pomology, U. S. Dept. of Agriculture, 1887.

^c Harcourt, H. Florida Fruits, 1886.

^d Royle, J. F. Fibrous Plants of India, 1855, p. 260.

very rapid. In less than three weeks they attain their full size and are ready for picking (figs. 3, 4, and 5). If the "fruit," if we may so call it, is not now picked and the seed is allowed to mature, the plant dies early in January. There are in the axils of the leaves several latent flower buds, and when the calyces are picked as soon as they



FIG. 1.—Roselle plant.

are full grown these buds develop and the productivity of the plant is greatly increased.

VARIETIES.

The roselle being a plant of recent cultivation and one that only to a slight extent has been exploited for commercial profit except as a fiber plant, it having been grown mostly as a curiosity in the gardens of interested individuals without any thought of improving the

plant, it is only natural that no cultural varieties have developed.^a Without any thought of improving the roselle, the writer during the summer of 1904 obtained a few plants in Coconut Grove, Fla., from Mr. W. A. H. Hobbs and planted them in the Subtropical Garden, Miami, Fla., in order to have the plant under observation.

As the plants bloomed and fruited the marked variation in the fruits on the different plants suggested that there was an excellent opportunity to breed a new and distinct strain of the roselle, and at the suggestion of Prof. P. H. Rolfs, at that time Pathologist in charge of the Subtropical Laboratory and Garden, seed was saved from the best plants. With this seed for stock the writer began systematized breeding the next year. A number of the plants fruiting in the autumn of 1906 had calyces

of such large size and exhibited such distinct characters that they were thought worthy of naming as a variety, and the name "Victor" has therefore been given to this sort.

The improvement of these plants over the common kind is best illustrated in figure 5. When it is remembered that these are from plants in the second generation, the improvement is remarkable. As it was thought that these plants might be a special strain, inquiries were made to find out whether the original plants had any previous history, but this inquiry only served to confirm the fact that they were of the ordinary variety grown in Florida. Mr. William A. Taylor, of the Bureau of Plant Industry, suggested to the writer that this capacity for improvement might be due to the fact that the roselle has previously been principally grown for fiber, which doubtless is correct. Another attempt to breed the roselle was made by Dr. H. J. Webber in the nineties at Eustis, Fla., where the Subtropical Laboratory was then located. This work was, unfortunately, terminated by the severe freeze of 1895.



FIG. 3.—Mature calyces of the ordinary roselle, somewhat affected by mildew. (Three-tenths natural size.)



FIG. 2.—Branch of the roselle plant, showing blossoms.

^a Since this article was written O. W. Barrett, of the Bureau of Plant Industry, has informed the writer that he has heard of a variety with straw-colored calyces. This report, however, has not been verified.

The plants of the Victor variety are inclined to be a trifle more dwarf than the common kind, but the foliage is similar. The measurements of the calyx of the common variety are, length 33 mm., diameter 22 mm.; in the improved type the measurements are 49 mm. and 28 mm., respectively. The increase in size is thus seen to be rather more in length than in diameter. Calyces of the improved type have in some instances been 60 mm. long and 38 mm. in diameter. (See the two detached calyces in fig. 5.) The improved type is also distinct in being more strongly ribbed longitudinally and in having the calyx not so closely appressed to the seed pod as in the common variety. It is frequently inclined to be convolute at the apex.



FIG. 4.—Mature calyces of the Victor roselle, somewhat affected by mildew. (Three-tenths natural size.)

CULTIVATION AND FERTILIZATION.

The roselle will thrive on any soil that is moderately rich or that is supplied with the necessary plant food in the form of commercial fertilizer. Stable manure should be used sparingly only

and should be supplemented by phosphates and fertilizers containing potash, as an excess of ammonia in the soil tends to the development of large plants at the expense of their productiveness. This is particularly true on low-lying land where moisture is abundant, and the high pine lands in Florida are for this reason preferable to the muck and prairie lands. Land that is subjected to inundations and soil insufficiently drained should be avoided. The plant has been found well adapted to the clayey soil of California. Henricksen^a says that a sandy loam is preferable to other soils.

The roots of the roselle descend to greater depths than those of many other crops, and the land should be plowed deep and, when the

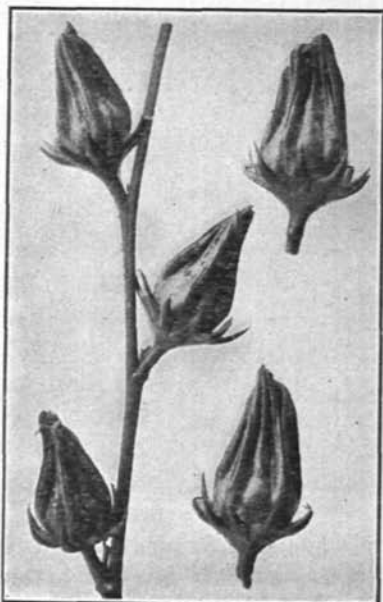


FIG. 5.—Mature calyces of the Victor roselle. (Two-fifths natural size.)

^aBul. 171, Office of Experiment Stations, p. 38.

soil is clayey, well pulverized. This plant is very much subject to root-knot nematodes (*Heterodera radicumicola*) and should not be planted on land infested with this pest, as that would only result in almost absolute failure.

The roselle always comes to the market at the same time of the year, and, as no literature on the subject that had come to the attention of the writer mentioned any attempt to grow it successively, several sowings were made in 1906 at the Subtropical Laboratory at different times of the year, to note the influence on the habits of growth, the season of maturity, and, possibly, the size of the calyx. These plantings were made as follows: No. 559, April 1; No. 560, May 1; No. 561, June 1; No. 562, June 23.

Besides these, seeds from large selected pods were sown June 26 (No. 542). Plant No. 542 came into bloom October 26, a few days in advance of Nos. 560, 561, and 562. A few days later bloom was noted on No. 559. Notes made in 1905 show that plants from seed sown on June 10 bloomed October 25. The plants from the earlier sowings naturally developed into large plants, with greater bearing capacity. This advantage was offset, however, by the fruits being to a marked degree smaller than those from later sowings. A comparison of the different plants in this experiment indicates that to combine high yield with the production of large pods the seed should be planted about May 15 in south Florida.

Make the seed bed in a place sheltered from high winds and work in thoroughly a moderate quantity of stable manure or commercial fertilizer. Sow the seed thinly in drills 6 inches apart, covering the seed from $\frac{1}{4}$ to $\frac{1}{2}$ inch; then firm the soil and, if dry, water thoroughly. The seed will germinate in a few days. If the weather is dry, the young plants should be watered as occasion requires. When the plants are 3 to 4 inches high they are ready for transplanting to the field.

The plants should be set out in rows 6 to 10 feet apart and 4 to 8 feet apart in the row, according to the fertility of the land and the supply of moisture. The seedlings are easily transplanted if proper precautions are taken. The work should preferably be performed on a cloudy day or late in the afternoon. Where a few plants are desired for home use only it will be found advantageous to sow a few seeds where the plants are to remain permanently and when the plants are well developed to thin out to one plant to a hill.

Experiments with different fertilizers have been started at the Subtropical Laboratory, but have not been carried on for a sufficiently long time to indicate the best form in which the fertilizer should be applied. Meantime a formula of nitrogen, 4 per cent; potash, 7 per cent, and phosphoric acid, 6 per cent, has given good results. One-third of the actual ammonia is derived from nitrate of soda and the

other two-thirds from dried blood. The sources of potash and phosphoric acid are muriate of potash and acid phosphate, respectively.

The fertilizer should be applied at the rate of from 1,000 to 2,000 pounds to the acre, according to the fertility of the land. On lands rich in ammonia the nitrogenous elements should be greatly reduced. It should be understood that this applies to Florida soils and conditions. The amount, and possibly the formula, would probably have to be modified in other sections. In the sandy and leachy soils of Florida it will be found advantageous to make several small applications instead of applying the total quantity at the time of planting. No cultivation is necessary, except to stir in the fertilizer and to keep down the weeds while the plants are small. When the ground is well shaded by the plants cultivation may be discontinued.

YIELD.

During 1906 experiments were well under way to ascertain the total yield of the roselle plant, but a hurricane in October inflicted so much damage on the plants in the experimental area that accurate data were unobtainable. Henricksen^a quotes the yield as four pounds of fruit to each plant, averaging two pounds of calyces, the useful part, and adds, "Plants observed at Pueblo Viejo in sandy loam were estimated to yield double that amount."

HARVESTING AND MARKETING THE CALYCES.

In less than three weeks from the time of flowering, the calyces are ready for picking. In south Florida the first fruit is gathered about the middle of November.

It has been already pointed out how the yield may be largely increased by picking—going over the field every few days to pick the full-grown calyces, which will force the plant to send out new flower buds. By these repeated pickings the plants are forced to fruit continuously until late in February, whereas otherwise they would cease to bear in December. Moreover, the calyces are more brittle and more easily broken from the plants while young and tender, and in the manufacture of jelly make a lighter red and a more transparent product than those from the more mature fruit. On poor land it would be of advantage to make a small application of fertilizer to the plants in December.

The fruit is seen at present in local markets only and is sold by the quart. Its excellent qualities for making a sauce so closely imitating in flavor the cranberry as to deceive the very elect are not well known by the public or it would be a formidable rival in the South to that fruit, on which transportation charges are necessarily high owing to the great distance it must be transported. The crisp

^a Bul. 171, Office of Experiment Stations, p. 38.

and juicy appearance of the roselle is diminished by being too long in the hands of the dealer, but this does not indicate deterioration of its useful qualities.

COMPOSITION AND USES OF THE FRUIT.

In the roselle it is the large, reddish, fleshy calyces surrounding the seed pod that are used for food. As already stated, a considerable industry has lately been developed in Queensland, where the fruit is made into jam and exported. There is no reason why a similar industry should not grow up in the United States. The usefulness of the roselle as a substitute for cranberry sauce has been emphasized already, and its qualities for making jelly are unexcelled. In the United States it would probably become of greatest importance in the manufacture of jelly.

An analysis of the calyx was made by the food laboratory of the Bureau of Chemistry, which at the same time made an analysis of the cranberry for comparison, the uses of the two fruits being so similar. It will be seen from these analyses (see table below) that the constituents of the two fruits occur in nearly the same proportions, practically the only difference being that traces of benzoic acid in some form are present in the cranberry, while absent from the roselle.

*Comparative analyses of the composition of the roselle and the cranberry.**

	Roselle.	Cranberry.
	<i>Per cent.</i>	<i>Per cent.</i>
Water.....	88.91	88.53
Solids.....	11.09	11.47
Ash.....	.89	.25
Mare (insoluble matter).....	6.67	4.60
Acid (as malic).....	2.77	2.74
Reducing sugar as invert.....	.33	1.90
Sucrose.....	.03	.10
Benzoic acid.....	Absent.	Present.
Starch.....	Absent.	

* Weight of fruit of roselle, 6.11 grams; cranberry, 0.94 gram. Percentage of edible portion: Roselle, consisting of calyx minus the portion of its base which is cut away in removing the seed pods, 50.22; cranberry, 100.

In preparing for cooking, take the pod between the thumb and forefinger of the left hand, stem end up; cut off the stem and the basal end of the calyx to where the seed pod is united with the calyx, when a slight pressure with the fingers holding the pod will force out the seed pod. (See fig. 6.) After preparing in this way, the calyx may be used for making sauce, jam, and transparent, bright red jelly. Many other dishes will suggest themselves to the thrifty housewife.

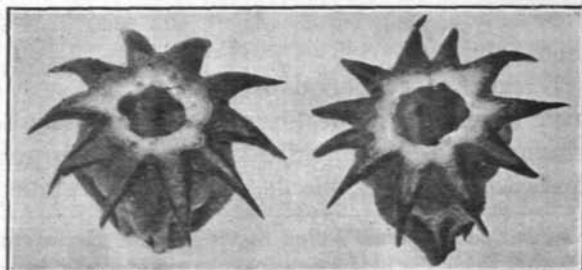


FIG. 6.—Calyces of the roselle prepared for cooking by removal of seed pod. (Four-fifths natural size.)

The calyces may also be separated from the seed pods and dried in the sun or in an evaporator, and are in this form, according to Mr. O. F. Cook,^a occasionally seen in the markets of the Tropics. The juice of the calyces could probably be boiled to a sirup and used as a flavoring extract at soda fountains, and the fruit might also be used in coloring jellies, jams, or similar products as a substitute for coal-tar dyes where a bright red color is desired.^b

USE OF THE PLANT FOR FIBER.

While this paper has been prepared primarily with reference to the utilization of the fruit of the roselle, the plant is, as previously stated, grown in India for its fiber, which is used in the manufacture of cordage and coarser textile products. Considered from this standpoint, the plant without further breeding could be cultivated over a large area in the Southern States, as the crop would be harvested before it was damaged by early frosts. On account of the vigor of the plant and its easy cultivation it is well worth a trial with this end in view. "For this purpose the crop is cut while in flower, dried, made into bundles, and soaked in water for fifteen or twenty days. It is then possible to wash out a strong silky fiber known in commerce as roselle hemp, considered by some to be the equal of jute. The leaves are sometimes used as a salad and the seeds are supposed to have medicinal properties. They are also fed to cattle and poultry."^c

BREEDING.

The roselle is an annual, and consequently seed must be saved every autumn for planting the next spring. To improve the strain the grower should go over his field repeatedly when the fruit is setting and tag such plants as combine great vigor with large bearing capacity and have calyces large and well formed. To obtain the best results in a comparatively short time it would be expedient to bag and hand-pollinate the flowers. When the seed pods turn yellow they should be gathered from time to time and dried, after which they are easily thrashed out. Keep the seed in a dry place secure from moths and rats.

During a long period of cultivation nearly all of our vegetables have become so domesticated that they may be forced to grow and produce at will where frostless conditions prevail; hence we have fresh tomatoes, eggplants, etc., in midwinter in the South. The

^a Contributions from United States National Herbarium, Vol. VIII, pt. 2, p. 160.

^b After this bulletin was prepared the writer was informed by Mr. W. W. Tracy, sr., of the Bureau of Plant Industry, that he, together with Mr. Coulter, made jelly from the small and tender branches several years ago. He adds that the leaves were picked off before boiling the stems.

^c Contributions from the United States National Herbarium, Vol. VIII, pt. 2, p. 159.

roselle, not having had this advantage, can at present be cultivated only where frost is unknown, or nearly so, as its growing period is very long and its blooming and fruiting season extends late in the year. Should it, however, be found desirable to grow the plant in temperate climates, there is no reason to doubt that the roselle would adapt itself to shorter summers. Its near relative, Sea Island cotton, is a striking illustration of how a plant may adapt itself to entirely new conditions, and the following quotations from Dr. H. J. Webber are, in this instance, of timely interest:

According to tradition and the reports of growers, Sea Island cotton when first introduced into this country from the West Indies was a perennial unsuited to the duration of the seasons of the latitude of the Sea Islands off South Carolina and Georgia, where it seldom matured fruit. However, through the selection of seed from early maturing individual plants and through better methods of culture, there has developed an improved race which now seems to be thoroughly adapted to the conditions of growth in the regions referred to. Furthermore, under the continuous and rigorous selection to which the plants have been subjected, the fiber has gradually improved, and now that produced along the coast and on the islands lying off South Carolina and Georgia is considered superior to that grown in any other part of the world. The custom of carefully selecting the seed has grown with the industry, and may be said to be inseparable from it, and it is only by such careful selection that the staple can be kept up to its present superior excellence. Several different strains have been developed, and are maintained by different growers selecting with different ideals in view. * * * This method and similar ones employed by numerous other growers are applicable, with slight variations, to most of our common crops, such as corn, wheat, etc.^a

About 1,785 seeds of this cotton were brought to Georgia from the Bahamas. Notwithstanding the good care they received and the mild winter, the plants were killed down, but they came up again from the roots and with this start succeeded in ripening a few seeds before the first frost in the fall. The earliest of these seeds were sown in turn and by continuing this process of selection the flowering period became earlier and earlier, until now the plants ripen a large proportion of their seeds before frost, even along the coasts of the Carolinas. Besides striving to obtain earlier maturing sorts, very careful selection has for years been made with a view to increasing the length, fineness, and strength of the staple. The selection is regularly practiced by all intelligent growers and to-day it may be regarded as one of the necessary cultural methods. Every year a special patch of cotton is grown from selected seed; the plants in this patch are examined very carefully and the seed of the best individuals retained for planting a similar patch next year, the seeds of the remaining plants being used to plant the general crop. Under such continuous and rigorous selection the length and fineness of the fiber have gradually increased until it is now recognized as superior to that grown anywhere else in the world and commands the highest price in the market.^b

With the object in mind of breeding an early-ripening variety of the roselle the breeder might find it expedient to harvest some of the seed before it is fully mature, as it has been shown that plants from green seeds—tomatoes, for instance—have a tendency to mature fruit earlier than plants from ripe seeds.

^a Yearbook, Department of Agriculture, 1898, p. 358.

^b Yearbook, Department of Agriculture, 1899, p. 490.

FUNGOUS DISEASES AND INSECT ENEMIES.

The only disease that has so far been noted on the roselle is a mildew (*Oidium* sp.) which attacks all parts of the plant above ground and under favorable conditions appears capable of doing considerable damage in discoloring the fruit and in lessening the vitality of the plant. (See figs. 3 and 4, showing mildew on the calyces.) Where its presence was noted, however, the greater part of the crop was gathered before the mildew made its appearance, making the loss of fruit comparatively small. Experiments have not been made to find a remedy, but sulphuring the plants would probably be found to be effective. Bordeaux mixture would without doubt prove efficacious, but would also in all probability tend to discolor the manufactured product.

The most serious enemy of the roselle is the root-knot nematode (*Heterodera radicola*). A cheap and effective remedy for this pest has not yet been found and infested lands should not be planted with the roselle.

The soft scale (*Coccus hesperidum*) has been noted on the roselle, but has not yet assumed the character of a pest. Its activity is restricted to the stem and lateral branches close to the ground. The scale is distributed by a small black ant.

The cotton stainer (*Dysdercus suturellus*) has been observed on the plants in limited numbers, but does not appear to be injurious.

The yellow aphid (*Aphis gossypii*) has been known to do considerable damage on individual plants by attacking the leaves and flower buds and causing the calyces to drop. It has not, to the knowledge of the writer, appeared as a serious pest. Remedies for this species, better known as the melon or cotton aphid, are considered in Circular No. 80 of the Bureau of Entomology of this Department.

SUMMARY.

The roselle is an annual from the Old World Tropics.

It is extremely sensitive to frosts, and can at present be grown for its fruit only in tropical and subtropical countries.

Being easily cultivated when the climate is favorable, the roselle should be in the garden of every family, and on account of its excellent qualities for making jellies, jams, etc., it is certain to become an important plant in the manufacture of those products.

The young stems also make good jelly. For such use the plant can be grown almost anywhere in the North or South.

By proper methods of breeding it is possible to obtain strains with larger calyces. Probably earlier bearing races can also be obtained by careful selection of the earliest flowering plants.