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CANTALOUPE BREEDING

BY

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CANTALOUPE BREEDING

PHILO K. BLINN

The cantaloupe industry has made its principal development since the introduction of the Netted Gem variety; for due to its small uniform size and good carrying quality the growth of the industry has been possible.

It was not until the excellent quality of the cantaloupes produced on irrigated land under dry climatic conditions was realized, that the industry became prominent.

The first cantaloupes on the eastern markets from the arid region were shipped from Rocky Ford, Colorado, in 1896. Their superior flavor was an innovation to the eastern melon trade; the contrast in quality was so striking as compared to the eastern and southern products that the Rocky Fords at once became regarded as a new variety, and under that popular symbol have won a national reputation. Each year thousands of cars of cantaloupes are marketed as genuine Rocky Fords, but from widely distant fields; those from the southern states appearing on the markets early in May, and continuing the supply from various states until late in October.

The phenomenal growth of the industry and the great demand, has established the cantaloupe as one of the favorite fruits of the American table; if the quality could always be assured there is hardly a fruit that could rival it in popularity or price.

Some of the causes that lead to poor quality are: Unfavorable climatic conditions, plant diseases, insect injuries, glutted markets and the unavoidable delays in transportation; many of which are beyond any apparent means of control. Yet when we consider what has been accomplished by plant breeding in other lines, it does not seem impossible that there could be developed a disease-resistant cantaloupe that would possess such superior qualities as to enable it to endure adverse conditions and still reach the markets in better state and with higher flavor than any we now possess. To this end cantaloupe breeding becomes an important feature of the industry, for at best the crop is a hazardous one, due to the above named influences and until recently careful seed selection has been generally neglected.

A GOOD DEMAND FOR GOOD SEED.

The general growth of the industry has created a large demand for cantaloupe seed, and naturally Rocky Ford has been an important source of supply. It seems that it is more than the notoriety of the name that gives an intrinsic value to the seed produced

at this point, for the cantaloupe growers of California and the southern states look to Rocky Ford each year for their supply of seed. They unanimously concede that they can mature their melons a week to ten days earlier and be assured of more uniform results in regard to size and quality, when they plant the Colorado grown seed, than if they use the same strain after it has been grown native with them a year or so. It is a good instance of the change in plants, that environments may sometimes produce, and how these variations may be transmitted to a degree, when the plants are grown under other conditions. The effects of altitude and latitude have long been regarded as an influence that hastens maturity in plants when their seed are grown in lower or southern regions. It is also a notable fact that grains produced in the dry climatic conditions of Colorado are heavier per bushel and are superior in quality to that grown in humid sections where the rainfall is excessive; it is evident, that where the moisture is controlled, and the soil and weather conditions will develop the fine flavor and qualities found in the Rocky Ford cantaloupe, that the same conditions will, in a measure, lend an influence to mature the seed with superior germinating power, vigor of growth and strong inherent tendencies, over that produced in less favored localities. This would indicate that points in Colorado are destined to continue as superior cantaloupe seed growing centers, provided the growers will resort to the proper methods of seed breeding that will insure the improvement of the cantaloupe in all its possibilities.

INDEFINITE AND UNSYSTEMATIC SELECTION.

Those familiar with the subject realize that a large amount of the seed that has been saved in the past was not choice selected seed, for much of it is saved from cantaloupes that were unmarketable for some reason, or it was saved late in the season from immature melons after frost has destroyed the vines; improvement under such conditions would hardly be expected and deterioration would be almost inevitable. However, there are growers who have been interested in producing choice cantaloupe seed, but even at best their system of selection has been too indefinite and incomplete to insure the best results. The plan of most growers in selecting seed for their own planting, is to lay aside the choicest specimens from the piles as they are gathered for market; these may be further graded before they are finally saved for seed, which would seem that the system possessed some merit, yet it is quite analogous to the use of the fanning mill for developing improved grain, or the selection of seed corn from the crib to better the corn crop; the selection is incomplete, for the seed selected from an indiscriminate pile does not take into consideration the many inherent tendencies of the plant from which it was produced, no matter how

perfect the specimens may chance to be; another serious weakness is the lack of adherence to a definite outline of the qualities that should be embodied in a perfect cantaloupe.

The different ideals of selection have given rise to numerous strains of the Rocky Ford cantaloupes, which are simply the Netted Gem variety developed under different conceptions of type and quality; there may be the element of cross-fertilization in the origin of some of the strains yet the foundation stock of all was originally the same strain, and the general characteristics of this variety has constituted the principal lines that have been considered in the selection of the Rocky Ford seed. For example, the uniformity of size and the netting are points that have been considered and are well developed in several strains; yet equally essential are the inherent traits of the plant and the quality of the fruit. For example, early, prolific production and disease resistance are of prime consideration as well as a thick, fine flesh of rich flavor with no disagreeable consistency or after tastes which are all qualities that should be embodied in a perfect cantaloupe.

Doubtless the acme of perfection may never be realized, for some of the points may be antagonistic attributes, and the laws of plant breeding are not so well defined as to enable one to outline a scheme for seed selection that will insure the desired results in a given time.

AN EXPERIMENT TO IMPROVE CANTALOUPE.

The object of this article is with a view of outlining the methods and results of a definite investigation along this line, presenting the facts that have grown out of this work in such a way as to serve the future efforts in cantaloupe breeding.

The Colorado Experiment Station, in 1903, instituted an investigation to develop if possible, a cantaloupe that would be immune to the attacks of the fungus disease, commonly known as "melon rust" or "blight," which is a serious menace to the melon industry. The first effort was a study of the cantaloupe fields to ascertain if any resistant tendency existed in the various strains of the Rocky Ford cantaloupes.

Owing to the different soil and the cultural conditions of the different farms, it was impossible to draw conclusions, as all fields were affected to some extent and eventually all succumb to the disease.

It was evident that a comparative test under more uniform conditions would be necessary to determine the point in question. Accordingly the following season the principal strains of the Rocky Ford cantaloupes were tested in comparison on a piece of ground that had been seriously affected with the fungus. The plat was uniform in condition and had the same care in all respects, yet the

results of the test revealed that one of the strains had marked disease resistant qualities, for when the balance of the plat was practically dead and dried up with the disease the rows of this variety had a number of plants only slightly affected.

The seed of these resistant individuals were secured and the following season, 1905, the same plat of ground was again used, in order that the rust-resistant feature could be developed in as adverse conditions as possible. It chanced this season that one of the rows in the plat was planted with the seed of one cantaloupe and the product of this row was so uniform in all of its qualities that it was evident that individual selection was an essential point to consider; also the increased percent of the resistant plants gave evidence that the quality was transmitted and could be developed by seed selection.

The seed of the most resistant plants were again saved, but this time each one was kept separate, the next year, 1906, the same plat was again used. The test demonstrated that the product of some plants reproduced quite uniformly and in others there was a tendency to vary; this seemed to emphasize the importance of selecting individual melons as well as the plant, and isolating the breeding plats as far as possible to prevent undesirable crosses. One row in the plat was planted as a check row, with the seed of a very choice melon but which had not been selected for the disease-resistant quality. This row was destroyed with the rust at least two weeks before the balance of the plat gave signs of the disease to any extent. (Plate I)

As the disease began to develop in the plat, a careful study was made and the most resistant plants were numbered by a stake, and as the melons ripened the most desirable were selected and the seed saved separate with a descriptive record made of each. Near the close of the season the plat was gone over again and noted as to which plants had been the most resistant during the summer; this revealed the fact that a few had been more enduring than all the rest. The seed of these could be easily identified and those that scored the highest in points of quality, were selected for the work in 1907. The seed were planted in separate adjacent blocks of fifty hills each on the same old plat that now, for five consecutive years had been devoted to cantaloupes, which is enough to insure a failure on account of the disease with any of the ordinary strains of seed after it has been grown on the same soil so long; but since the beginning of the resistant selection the plat has shown a decrease in the presence of the disease, while in adjacent fields the fungus has been as prevalent as ever and even more destructive. Except for a few individual plants, the plat during the past season has been practically free from the disease.

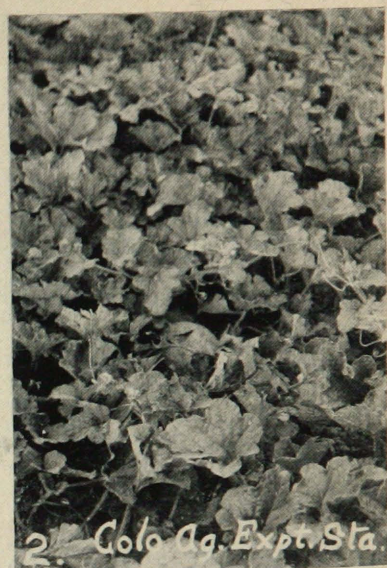
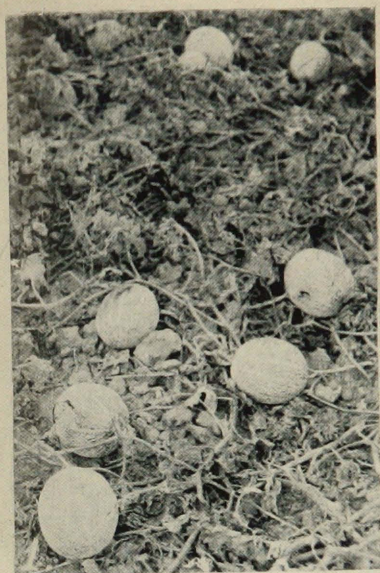


PLATE I.

1. A VINE RUSTED ON CHECK ROW
2. ADJACENT VINE SHOWING RESISTANCE TO RUST

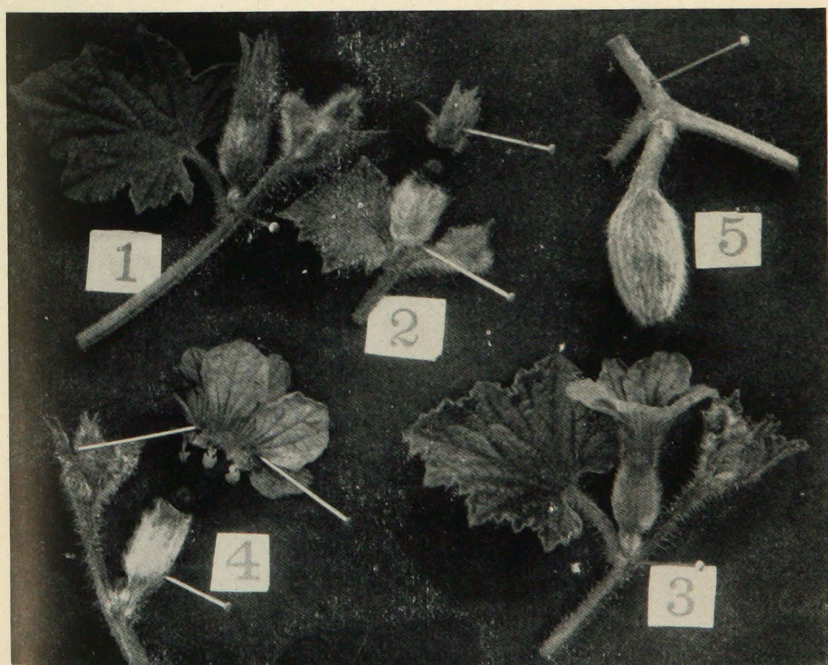


PLATE II.

1. BUD 24 HOURS BEFORE OPENING
2. BUD EMASCULATED
3. BLOOM JUST OPENED
4. CALYX AND COROLLA REMOVED, SHOWING 3 ANTHERS ATTACHED
5. SET DEVELOPING

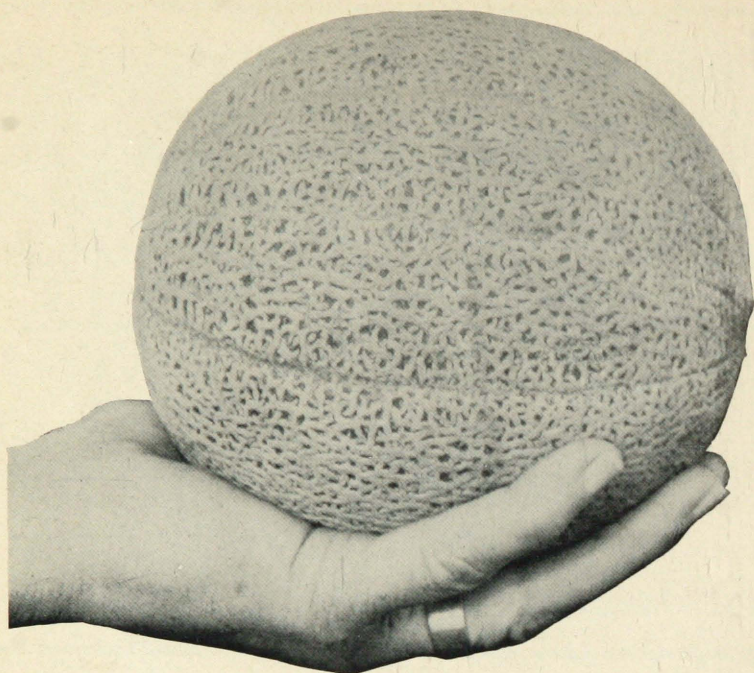


PLATE III.
EXTERNAL POINT OF NETTING AND SIZE

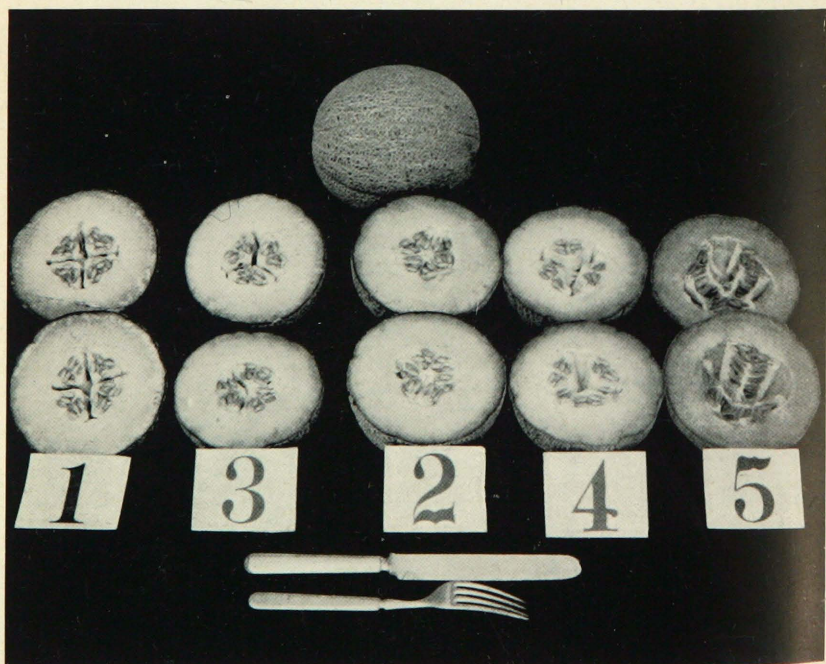


PLATE IV
CONTRASTS IN INTERNAL QUALITIES
NO. 2—PERFECT TYPE

PRACTICAL TESTS OF THE RESISTANT STRAIN.

Several tests of the rust-resistant strain were made with commercial growers in the vicinity of Rocky Ford, and all the reports have been of a flattering nature. Similar tests were also made in Illinois and Indiana through the co-operation of the Experiment Stations in those states, and the following copies of letters are the reports sent in.

From C. G. Woodbury, Assistant Horticulturist of the Agricultural Experiment Station, Purdue University, Lafayette, Indiana, under date of August 30, 1907:

"You remember that you forwarded me some seed early last spring, of your new strain of the rust-resistant Rocky Ford melon. I placed this out in several localities in Southern Indiana, where the rust is usually prevalent, and am very pleased to report that your strain has proven to be nearly immune; in one place where there was a small patch directly across the road from a field which the rust ruined entirely, the vines from your seed showed no effects of the disease whatever. To test the matter as severely as possible I had badly affected runners from the field that was dying of the rust cut off and scattered among the plants of the rust-resistant strain; even then they became affected only slightly.

"No doubt before this you have had a visit with Professor Orton of the Department of Agriculture, and he is able to corroborate my statements, since I had the pleasure of visiting some of the fields with him in Southern Indiana a short time ago."

From John W. Lloyd, of the University of Illinois Agricultural Experiment Station, Urbana, Ill., October 2, 1907:

"The melon seed you so kindly sent me last spring exceeded my highest expectations in reference to rust-resistance under Illinois conditions. I distributed the seed among a number of the commercial growers located at different points. Many growers lost or failed to plant the seed or did not secure a stand, but with all who succeeded in growing a crop the results were the same: The vines remained green and vigorous after other melons were dead from the rust; the melons netted exceedingly well and were fine flavored. The only objection raised against the melon was its late maturity; in some cases the entire crop from other varieties had been marketed before any ripe specimens of the rust-resistant could be found. It is true that the maturity of the other varieties was hastened by the rust.

"I believe this melon will be exceptionally valuable for extending the season after other varieties are gone. However, in our experimental plot where the other varieties were protected by spraying and the rust-resistant plants left unsprayed, there was not so much difference in the time of ripening, though the rust-resistant were somewhat later. Toward the end of the season the **unsprayed** rust-resistant vines were in better condition than the sprayed vines of the other variety.

"The small lot of exceptionally select seed which you sent was planted by itself at a distance from other melons, and the plants thinned to one in a hill. There was considerable difference in the rust-resistance of different plants, and I have saved seed from some of the most resistant with a view of planting each separately, and making further selection next year."

The results of the investigation have demonstrated the possibility of controlling, to some extent at least, the injuries from the "rust" fungus by systematic seed selection and breeding.

VARIATIONS OF INDIVIDUAL SELECTIONS.

The seed of eighty choice individual cantaloupes of the rust-resistant strain were planted, on alfalfa sod, in blocks of twenty-five hills each, under as uniform conditions as possible. The object of this test was to determine the efficiency of the disease resistance on soil less affected with the fungus, and to study the problems of individual variation from individual selections, with a view of improving other characters in the Rocky Ford cantaloupe.

The test did not reveal any greater disease resistance by virtue of the alfalfa sod, but a marked contrast in the degree of resistance was revealed in the plats of different individual selections.

The variations of some of the plats made it easy to distinguish their outlines after the vines had run together and completely covered the ground in the field. The seed was all of the same variety and had been carefully selected for several years, and was considered a pure strain.

Had the seed been jumbled together and planted as usual, the contrast and variations of the different selections would not have appeared to attract attention, but by planting each separately it was evident that it makes a vast difference in results which one was chosen for seed, even from a number of seemingly choice specimens.

The first contrast noted was the variation in the germination of the plats, which ranged from forty to one hundred percent and was clearly the result of vitality in the selections, the date of first setting fruit varied eight to ten days in different plats without apparent reason, and the time of ripening of some of the plats was prolonged to nearly three weeks, though this difference may have been partly due to the premature ripening of some of the plats most affected with the fungus, and as the most rust resistant selections were usually the latest maturing plats, yet it was clear from the early setting and development of the plats before the disease was manifest, that some of the plats were much earlier than others. There were also various combinations of the different qualities in the different plats; for instance, the rust-resistant feature was associated with excellent melons in regard to netting, form and size, in some plats, while in others the qualities were inferior in this respect.

When the pedigrees were traced a general uniformity prevailed in the plats whose seed had a common parentage a year or two previous, yet irregularities were constantly appearing in the products of some of the selections, and also the tendency to breed true seemed equally characteristic of others. In one instance the color of the flesh and the solidly filled seed cavity was uniformly reproduced for four succeeding years.

The variations of the individual selections seemed to come from no other reason than the inherent tendency of the individual, for the whole plot had the same care in every respect possible.

The recent application of Mendel's laws of heredity offers an explanation of the results observed in this experiment. The heterozygous unit factors of some of the selections produced the irregular variations, while the homozygous, or pure unit factors of others, resulted in characters breeding true.

HYBRIDIZATION.

So far in the investigation we have employed only seed selection to secure the desired results; but now the need of hybridization is manifest to combine the desired qualities found in different selections, for simple seed selection has been inadequate to this object. To combine the rust-resistance with earlier maturity is much desired, and to this end observations and tests have been made during the past season to ascertain the fact and methods necessary for artificial cross-fertilization of the cantaloupe flowers. As a result several cross-pollinations were made between some of the best selections of the rust-resistant strain and an abnormal early setting plant of another strain known as the "Watters." According to Mendel's law of constant proportions resulting from such hybrids, we may confidently expect the desired combination if the qualities are compatible.

It was found by observations that the flower of the Rocky Ford cantaloupe is quite the exception to most of the cucurbitaceous plants like the cucumber and many other varieties of melons, which have their stamens and pistils borne in separate flowers, while the Rocky Ford variety is hermaphroditic, that is the stamens and pistil are produced in one flower. It also has purely staminate flowers produced in great profusion at the intersection of nearly every branch.

It is evident that cross-fertilization is readily possible, yet the arrangement of the flower and the results of observation would indicate that self-pollination is quite as common or more so.

The numerical arrangement of the flower was found to vary, the three-lobed pistil with three stamens was the common form, but four and even five were encountered. The result of a three-lobed pistil is shown in No. 1 in Plate IV.

METHODS OF ARTIFICIAL FERTILIZATION.

The pollen of the cantaloupe flower has been found to ripen about the time the flower is opened and the pollen is usually shed at this time, which is usually early in the morning; to fertilize the flower and have the results of known origin, it is necessary to find the bud about twenty-four hours before it opens (Plate II,

No. I), which can easily be told by observation; in this stage it should be emasculated, before the pollen lobes are ripe. By cutting around the base of the corolla and calyx, the two may be removed with the stamens attached, leaving the pistil free and exposed. (Plate II, No. II and IV.) A small paper sack is then tied over the stem to protect the pistil from foreign pollen until the following morning, when the stigma will be at about the same stage, as if the flower had not been disturbed, and ready to receive the pollen.

The desired pollen is introduced from a fresh opened flower, by pulling off the corolla the stamens are exposed, showing the ripe pollen grains which are transferred by touching the ripe pollen lobes to the pistil or stigma until it is well covered with the yellow pollen grains. The paper sack is then replaced for several days until development begins.

SUMMARY.

The general conclusion of the investigation is that systematic seed breeding will intensify any desired qualities found in cantaloupes, as well as in corn and other crops.

The essential points for breeding cantaloupes are:

1. Keeping records that will establish the history of a plant at any time.
2. Close observation to detect desirable variations.
3. Individual selections.
4. Comparative testing to determine relative merits.
5. Judging the average results of a selection rather than the behavior of an individual in it.
6. An understanding of physiological botany, in order to perform successfully cross-pollination when necessary.

The principal points, or unit characters to consider, might be enumerated as follows:

1. Germinating vitality.
2. Vigor of growth.
3. Early setting.
4. Quick maturity.
5. Prolific yields.
6. Uniformity of the desired qualities in the product.

The standard for the Rocky Ford Cantaloupe of today might be given to include the following qualities:

1. Proper size to pack in the standard crate.
2. Fine, heavy, light grey netting, covering the entire melon. Plate 3.
3. Color character of the background or interstices between the netting, such as will indicate to the eye, by a slight change of tint, when the cantaloupe is ready to pick, which is rather an olive green, and one that does not turn yellow fast.
4. A thick flesh and solid filled seed cavity. (Plate 4, No. 2.)
5. A firm, smooth texture, fine grained and free from any fiber or water-core.
6. A green colored flesh is usually preferred, though commonly it is combined with orange or salmon tint.
7. The flavor is the ultimate test; it should be rich, sweet and spicy, free from any disagreeable consistency or after tastes.

If the same care and attention was paid to the breeding and growing of improved cantaloupes, or other crops, there would be a great demand for pedigreed seed, as well as the call for registered horses, sheep or cattle.