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LOUISIANA COPENHAGEN CABBAGE
Methods of Breeding and Description
JULIAN C. MILLER

LOUISIANA STATE UNIVERSITY
AND
AGRICULTURAL AND MECHANICAL COLLEGE
AGRICULTURAL EXPERIMENT STATIONS
C. T. DOWELL, Director
LOUISIANA COPENHAGEN CABBAGE
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JULIAN C. MILLER

While the author was associated with the Department of Vegetable Crops, Cornell University, from 1925 to 1928, there was occasion to examine the interiors of a large number of heads of cabbage from the leading varieties and strains. A great degree of variability was found in all of these, even in the Copenhagen Market which is considered the most uniform type of all the varieties. Since the Copenhagen Market is one of the most important varieties the author became interested in its further improvement, especially in developing a strain with a more compact head, a shorter core, resistant to cold and to premature seeding.

In the fall of 1927 sixty of the most ideal plants of the Copenhagen variety were selected for breeding from the trial ground plots of the Department of Vegetable Crops. In the trial ground there were nine different strains which had been obtained from leading seed growers.

METHODS OF BREEDING

Method one: The outer leaves were removed from the selected plants. The plants were then placed in cold storage at 40° F. and allowed to remain there for two months. They were then removed to the greenhouse, potted in 8 inch pots, and placed under growing conditions at 60 to 70° F. As soon as growth activities of the seed-stalk had begun an “X” cut was made across the top of the head in order to allow the seed-stalk to emerge more easily. The plants were kept pruned to a single flowering stem, and before the first flowers opened the seed-stalks were covered with a glassy bag to prevent foreign pollination. The bags were made fast at the bottom by using a paper clip, and they were removed only when the flowers were worked. All of the instruments used in the breeding work were sterilized in alcohol before moving from one plant or treatment to another. Each flower was hand pollinated in the late bud stage. Many of the strains were sterile or partially sterile, especially after the second generation of inbreeding. All of the strains but three were discarded after the second generation because of sterility, loss of vigor, and poor type. From the beginning, one of these strains, which was Hartmann’s Strain No. 2, was very easy to self, and quantities of seed could be obtained for field studies. Such progress was made with this strain that the author felt safe in discarding the other two and devoting all the efforts to the promising lines of this strain.

Up to this time the major efforts of breeding had been to find a strain which would lend itself to a program of inbreeding. Since such a strain had been found a more intensive project was set up in the fall of 1929, after the writer had accepted a position with the Agricultural Experiment Station, Louisiana State University, Baton Rouge.

Method two: After coming to Louisiana two methods of handling the seed plants were used, method one, as described above, and method two as will here be described. The seed were sown during the latter part of July and through September. During November and December the desired plants were staked and the heads cut and examined for such characters as compactness, color, flavor and the height and size of core. If the head was satisfactory the stump was marked by placing a stake beside it. As soon as compact rosettes had grown from the stumps they were transplanted to a seed plot and spaced 3 feet in rows which were 3½ feet wide. If method
one was to be used the rosette stumps were placed in cold storage at this time. The stumps lived better if the rosettes were allowed to grow out before transplanting. All of the rosette sprouts except about five were pruned from the stump. These leafy rosettes resisted freeze injury better than solid heads. Most years during December, January, and February the mean temperature, 52.3°F., was low enough at Baton Rouge to initiate seed-stalk development. However, some winters are too warm for seed-stalk formation. In this case sufficient stump rosettes and heads were placed in cold storage and were brought out the first of February and placed in the field or greenhouse for seeding. If the seed plants were to be grown in the greenhouse they should be removed any time during the winter after they have had their rest period for two months at 40°F.

All plantings were made early enough to allow the seed-stalks to emerge during early March; later than this the temperature would be too high for seed-stalk formation, and only vegetative growth would result. The seed usually matures during May.

The flowers were hand pollinated in the late bud stage using self or sib pollen. When available, self pollen was used. The flowers were covered with glascene bags and fastened at the bottom with a paper clip. In the field and in the greenhouse stakes were placed beside each plant to support the seed-stalk.

HOW THE ABOVE METHODS DIFFER FROM THOSE USED ELSEWHERE

In using the method just described one can examine the internal characters of the head and can select for such desired characters as short core, compact upright head leaves, quality, and other characters which may be desired. In all of the breeding with this strain the author has kept in mind the above characters and has selected plants possessing these qualities. It has been found that the best time of the year to study the different types of segregations is during November, December and January. At this season the different characters are more sharply contrasted than at other seasons. This may be due to the low temperature and to the short days prevailing at this time. In using either of the above methods a crop of stock seed can be produced each year.

DESCRIPTION

This strain will be known as Louisiana Copenhagen. It is the product of five generations of inbreeding and selection. The object was to develop a type of cabbage which the house-wife is demanding; that is, a small to medium sized, compact head of excellent quality. At the same time the growers' ideas and suggestions have been kept in mind. They have asked for a uniform strain of an early Copenhagen type which matures uniformly and is resistant to premature seeding, and one which produces a solid compact head of high quality under southern winter and early spring conditions. Louisiana Copenhagen represents to a marked degree the above qualities.

In describing Louisiana Copenhagen comparisons will be made between it and a select strain of Copenhagen Market which was used as a standard for comparison.

PLANT CHARACTERS

The plants are uniform and mature about one week earlier than Copenhagen Market. The plant is compact, upright, and small to medium in size. See Fig. 1. It has a spread or width of 18 to 20 inches while that of the standard Copenhagen has a width of 26 to 28 inches.
A relative comparison can be made by studying the two types of plants shown in Fig. 2. The plant at the left is the Louisiana Copenhagen, while the one at the right is the standard Copenhagen Market. The Louisiana Copenhagen is darker green in color, having heavier bloom on the leaves than the standard. The mid-ribs of the leaves of the standard Copenhagen are more prominent than those of the Louisiana Copenhagen. Also the lateral ribs of the leaves of the Louisiana Copenhagen are branched from the mid-rib at a sharper angle than those of the standard Copenhagen. This can be noted in detail in Fig. 3 which shows a typical leaf of the standard at the left and of the Louisiana Copenhagen at the right.
Fig. 2. Typical plants of the Louisiana Copenhagen and standard Copenhagen Market. The plant at the left is the Louisiana Copenhagen; plant at the right is the standard Copenhagen Market.
Fig. 3. Typical leaves of the standard Copenhagen Market and the Louisiana Copenhagen. Leaf at left is typical of the standard Copenhagen Market. Leaf at right is typical of the Louisiana Copenhagen.
The general outline of the leaf of the standard Copenhagen is round with a smooth surface and margin, while the leaf of the Louisiana Copenhagen is slightly oblong with the outer surface and margins distinctly waved.

**HEADE CHARACTERS**

Since the head is the marketable portion of the plant a great deal of thought and effort have been devoted to the improvement of desirable head characters in the breeding of Louisiana Copenhagen.

Upon examination of a mature plant, see Fig. 1 and 2; only one wrapper leaf is required to cover the top of the head. Table I shows a comparison of head measurements of Louisiana Copenhagen with those of Copenhagen Market. It will be noted that the average weight of the Louisiana Copenhagen is 2.6 pounds, which is a most desirable size for the present day family. The shape of the head can be classed as round. However, there is a slight tendency for the head to be a fraction longer than wide. The reverse can be said of the Copenhagen Market.

The core of the Louisiana Copenhagen is less than one-half the length of the head, while the core of the Copenhagen Market is equal to or greater than one-half the length. This comparison may be better illustrated by examining Fig. 4 which shows the internal characters of both strains. As stated above under methods of breeding, considerable attention has been given to the improvement of the internal characters of the head, especially core length and character of the leaf folds. In the breeding work of the past very little attention has been given to these two characters.

**TABLE I**

**COMPARISON OF HEAD MEASUREMENTS OF THE LOUISIANA COPENHAGEN WITH THOSE OF THE COPENHAGEN MARKET**

Average Measurement of 75 Representative Heads of the Spring Crop—1934

<table>
<thead>
<tr>
<th>STRAIN</th>
<th>Weight in lbs</th>
<th>Width in inches</th>
<th>Length in inches</th>
<th>Length core in inches</th>
<th>Ratio of core length to head length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Louisiana Copenhagen</td>
<td>2.63</td>
<td>5.80</td>
<td>5.86</td>
<td>2.49</td>
<td>0.425</td>
</tr>
<tr>
<td>Copenhagen Market</td>
<td>3.74</td>
<td>6.59</td>
<td>6.37</td>
<td>3.67</td>
<td>0.576</td>
</tr>
</tbody>
</table>
Fig. 4. Heads in center show the character of the core and the leaf fold of the Standard Copenhagen Market. Heads at right and left of center show the interiors of the Louisiana Copenhagen, illustrating the short core and character of the compact leaf fold of this strain.
Fig. 5. An illustration in more detail of the type of core and the character of the leaf fold of the Louisiana Copenhagen.
A short but stout core has been one of the characters sought. The core of the Louisiana Copenhagen has the same diameter for about three-fourths of an inch into the head where there is a sharp turn to the point of intersection, forming an "A" angle. The short and sharp angled core of the Louisiana Copenhagen permits the leaves to grow out and up at a more acute angle, allowing the leaf 'old' to become compact at the base and forming a thicker fold over the center of the head. The character of the core and leaf fold just described is shown in Fig. 4 in the heads at the left and right of the center, and again in more detail in Fig. 5.

To illustrate the variability found in a select strain of commercial Copenhagen Market, grown under conditions similar to those of the Louisiana Copenhagen, six heads were cut and photographed. These heads are shown in Fig. 6. Here it can be seen that all of the heads vary markedly as to their internal characters. Most of the cores are long and the head leaves grow from the core at almost a right angle. In some cases the leaves grow down instead of up as they should. The type of leaf growth just mentioned makes for loose heads.

Fig. 7. A detailed illustration of the compactness, size of core, and character of head leaf fold of Louisiana Copenhagen.
Fig. 6. An illustration of the variability of the core and leaf fold found in the standard Copenhagen Market.
DESIRABLE MARKET CHARACTERS

The Louisiana Copenhagen is more compact than the regular Copenhagen Market, especially when grown under the climatic conditions of winter and early spring in Louisiana. Although the head is somewhat smaller than the Copenhagen Market it is very compact; therefore a smaller number of crates is required to ship a given tonnage. Due to its size and compactness, as illustrated in Fig. 7, and to its high quality it apparently meets the demands of the modern market.

Stock seed of Louisiana Copenhagen was sent to Mr. T. Bacher of the Danish Experiment Station at Lyngby, Denmark, for increase. Mr. Bacher supervised the increasing of this seed for the Louisiana Agricultural Experiment Station.