

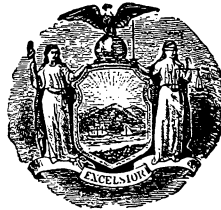
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New York State Agricultural Experiment Station

Geneva, N. Y.

GENEVA, A GREENHOUSE CUCUMBER THAT DEVELOPS
FRUIT WITHOUT POLLINATION

LESLIE R. HAWTHORN AND RICHARD WELLINGTON



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GENEVA, A GREENHOUSE CUCUMBER THAT DEVELOPS FRUIT WITHOUT POLLINATION

LESLIE R. HAWTHORN AND RICHARD WELLINGTON

ABSTRACT

The production of a cucumber satisfying the American market in shape, size, and color, and yet possessing also the desirable characteristics of parthenocarpy, i. e., producing fruit without pollination, and high yields of the English forcing cucumber, has for some time seemed desirable. An attempt at this Station has led to the production of a cucumber which fulfills these requirements. It is being distributed under the name of Geneva.

The breeding and selection work leading to its production is described. The parents are Arlington White Spine and Rochford Market.

Parthenocarpy was found to be if not completely recessive, at least partially so.

The Geneva represents selections from the fifth generation. A description of the vine and fruit follows: Vine vigorous and productive. Fruits very uniform in shape and size, about 10 inches long, $2\frac{3}{8}$ inches wide at greatest diameter about 3 inches from stem, tapering slightly in both directions, but rarely with any restriction at neck; surface smooth; color medium to dark green; flesh white, about $\frac{3}{4}$ inch thick; cavity small, not more than 1 inch across, containing a few small abortive seeds when unfertilized.

Two different markets under test indicated a preference for the Geneva.

INTRODUCTION

Growers of greenhouse cucumbers have always been confronted with the problem of pollinating the cucumber flowers in order to obtain a set of fruit. This difficulty has been more or less overcome by most growers thru the maintenance of bees in the greenhouse. Higher yields

are always wanted whatever the crop. It has been fairly well known that the English type of forcing cucumber sets fruits without pollination, and moreover, in most varieties, yields heavily. Hence, it has generally appeared desirable that an American type of cucumber having the two desirable characteristics of the English type be produced. An attempt was made, therefore, at this Station. This has resulted in a cucumber which is to be distributed under the name of Geneva. The breeding and selection work which has contributed to this new cucumber is described below.

The phenomenon of fruit being produced without pollination, natural or artificial, is called parthenocarpy. The English type of cucumber, therefore, is usually parthenocarpic, while the American type is not.

HISTORY

Investigations into parthenocarpic tendencies of cucumbers began at this Station in 1907 when two plants of a hybrid between White Spine and the English forcing Telegraph were examined for their ability to set fruit without pollination. The stigmas were covered with carbolized vaseline prior to the normal opening of the flowers to prevent fertilization. Some of the treated flowers dropped, while others produced seedless fruits which tapered at the distal end. The remainder of the hybrid plants set similar fruits, and as no bees were present owing to inclement weather, it was assumed that the cross was parthenocarpic. The flesh of the unfertilized fruits was slightly tougher and poorer flavored than that of the fertilized fruits, and later in the season after a hot humid period developed a hollow center.

In 1912, a more extensive study of parthenocarpy was undertaken. The objects in view were to determine first, how prevalent parthenocarpy was in cucumbers; second, whether it segregated like visible characters; and third, whether a commercial parthenocarpic type that was intermediate between the long English type and the short stubby American type could be produced. Pistillate flowers of a number of varieties were bagged prior to opening. Two fruits were obtained from a plant of Japanese Climbing which resembled the English forcing type, one from Thorburn Everbearing, and many from the English forcing varieties, namely, from Richard Invincible, Lockie Perfection, and Telegraph. No parthenocarpic fruit was obtained, however, from Early Green Cluster, Fordhook White Spine, Fiske White Spine, and first generation plants of crosses between White Spine and Telegraph

and White Spine and Richard Invincible. The results of this test indicated that the parthenocarpic character behaved as a recessive to the non-parthenocarpic character.

In 1913, one parthenocarpic fruit was obtained from a first generation plant of a cross between White Spine by Richard Invincible and one from three first generation plants of a cross between Fiske White Spine by Early Russian, hence parthenocarpy can not be called completely recessive. In a test of six plants of a back cross (Fiske White Spine by Richard Invincible) by Richard Invincible, only one parthenocarpic fruit was obtained. On the other hand, of the second generation of Fiske White Spine by Richard Invincible, 6 plants gave one fruit each; 1 gave two fruits; 12, no fruits; and 3, no test. Undoubtedly this number of fruits would have been greatly increased if bagging had been continued thruout the season. The fruits of the second generation were classed in most cases as intermediates, altho three plants were predominantly English. No selections were made from these crosses.

Canadian workers have already produced a parthenocarpic cucumber of a hybrid type. This is Hescrow which originated from crosses made by McLennan in 1910 and 1911, and referred to by Strong in 1921.¹ Hescrow was produced by crossing a first generation hybrid between an English variety, Sutton's Every Day, and Fiske White Spine with the German variety Princess and by making selections in the ensuing generations. It sets fruit freely and without pollination.

The Canadian workers carried on their observations on parthenocarpy over a period of years and in a letter dated November 16, 1928, W. J. Strong of Vineland states that every one of 33 varieties tested in a greenhouse with screened ventilators possessed the parthenocarpic character to a greater or less extent. The tests conducted at this Station confirm in part the results obtained in Canada.

Crosses between English and American types of cucumbers have not been uncommon. Some commercial varieties which originated from such crosses are Davis Perfect, Deltus, Rawson Hothouse, and Abundance. These cucumbers were not selected for, nor do they possess, complete parthenocarpy.

¹Strong, W. J., Greenhouse cucumber breeding. *Proc. Amer. Soc. Hort. Sci.*, **18**, 271-273. 1921.

PROCEDURE

The hybrid from which the Geneva (Fig. 1) cucumber was obtained was made in 1916 by crossing Arlington White Spine with Rochford Market, an English forcing variety.² Eleven first generation seedlings were grown in 1917. Plant No. 1 of this generation was selfed and in 1918 nine second generation plants were grown. Tests for parthenocarpy were made in both years. In 1918, all the plants were selfed.

Two years later (1920) five third generation plants derived from plant No. 1 of the second generation produced in 1918 were grown at the Maryland Agricultural Experiment Station. No plants were selfed and hence no seed was obtained.

The work then suffered from delay and interruption and it was not until 1927 that some more seeds from the second generation, which had been stored in envelopes for nine years, were planted in the greenhouse. This third generation seed in a number of cases, of course, germinated very poorly, but 39 third generation plants were obtained, including only 3 from plant No. 1 of the second generation progeny. As soon as the plants were large enough to bear fruit, their female flowers were bagged prior to opening in order to prevent insect visitation. The most satisfactory commercial and parthenocarpic plants were selfed and their seed saved for further tests.

In 1928, were grown about 50 plants of the fourth and third generations. As in the past, flowers had to be covered for a parthenocarpic test since the greenhouse was not screened. This year the unopened female flowers were covered with a little wad of absorbent cotton held in place by an elastic band. This procedure had several advantages over that of using paper bags. It was easier and hence quicker to perform than the clumsy bagging method; the development of the fruit could be watched without any further labor; the fruit developed under more normal conditions; and there was less chance of injury to young tissues of the flower and undeveloped fruit.

Many promising parthenocarpic selections were selfed in 1928. Some of these were crossed with each other. Others were discarded, as their fruits were lacking in one or more commercial characteristics.

In 1929, 65 plants representing various selections and crosses between selections were grown. These included five plants of Hescrow. No

²The cross was made by the junior author while he was connected with the Minnesota Agricultural Experiment Station, University Farm, St. Paul, Minnesota.

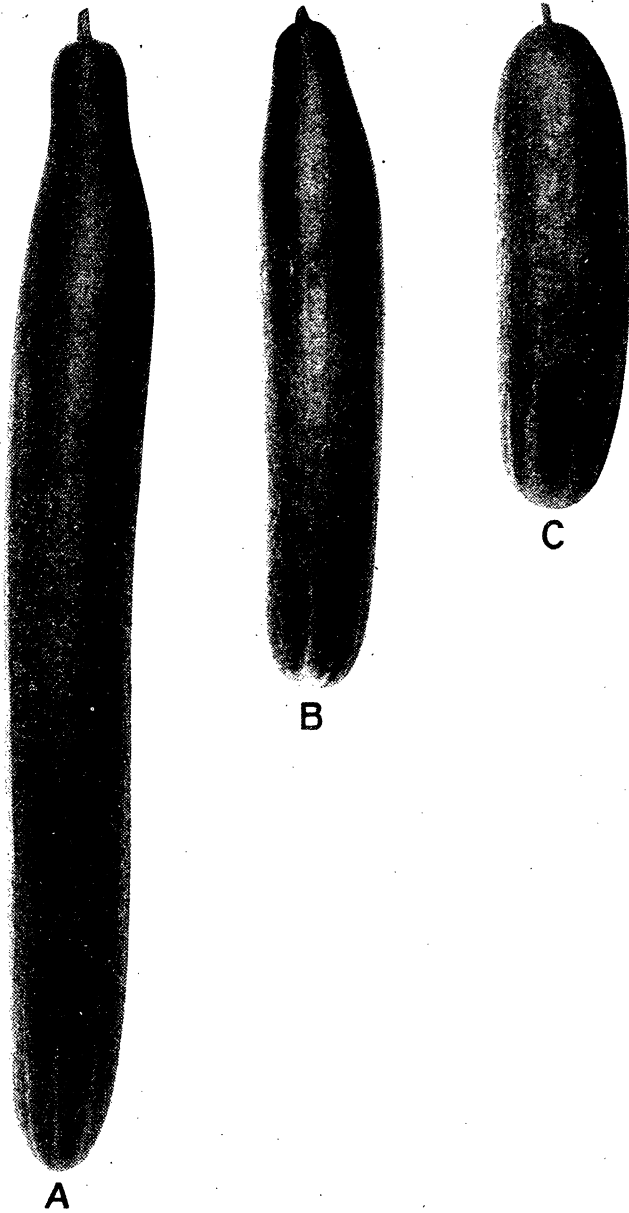


FIG. 1.—GENEVA AND PARENTAL TYPES.
A, English forcing type; B, Geneva; and C, White Spine or American type.
(One-third natural size.)

systematic testing for parthenocarpy was made, as it was felt certain that all the plants had this characteristic. The parthenocarpic fruits as they matured were gathered and marketed. Individual yield records were kept of each plant, and as the season progressed seed was obtained from the higher yielding plants by selfing.

RESULTS OBTAINED

1917-1920 TESTS

All of the first generation plants in 1917 bore fruits intermediate in length between Arlington White Spine and Rochford Market, warty like the former, and constricted at the neck like the latter. Neither these nor the White Spine were reported as parthenocarpic, altho Rochford Market was.

In 1918, of the nine second generation plants which came from plant No. 1 of the previous generation, only plant No. 7 was noted as having the parthenocarpic characteristic. However, plant No. 1 of this generation bore fruits having commercial possibilities, and judging from future results must have been parthenocarpic. They were described as being $10\frac{1}{2}$ inches long, not necked, tapering at the stem and abruptly at the distal end, slightly russeted, and similar to Abundance in appearance.

In the 1920 test, in which five third generation plants coming from plant No. 1 of the previous generation were grown, all of the five plants reacted parthenocarpically. In shape the fruits of the respective plants varied much, some approaching the Rochford Market, others the White Spine, and all lacked a constricted neck and wartiness.

1927-1929 TESTS

In 1927, it soon became apparent that the progeny of certain second generation plants was of no commercial merit, as they produced male flowers in great numbers, to the almost complete exclusion in some cases of female flowers. They also failed to give satisfactory results parthenocarpically.

Other progenies showed greater possibilities thru one or more favorable characteristics, such as high production of female flowers, parthenocarpic tendencies, and high production of edible fruit. The three plants which came from plant No. 1 of the second generation attracted particular attention as they were vigorous, produced female flowers in a normal abundance, reacted favorably parthenocarpically, and set

attractive high quality fruits. A typical parthenocarpic fruit cut from plant No. 1 of this group was $10\frac{1}{2}$ inches long and $2\frac{3}{8}$ inches at its greatest diameter about 3 inches from the stem. Altho the fruit tapered gradually in both directions, good thickness was maintained thruout and there was no restriction of the neck. The surface was smooth except for a few scattered white spines. Color was a medium to dark green, the general color being a little lighter than that so much in demand at the present time. The seed cavity was 1 inch wide surrounded by a layer of white crisp flesh averaging $\frac{3}{4}$ inch in thickness.

All the plants (third and fourth generations) which came from plant No. 1 of the second generation responded even better in 1928. Fruits not tested for parthenocarpy developed too, and because of their shape and the absence of bees, were assumed to be parthenocarpic. Later examinations of the seed cavities proved this assumption to be correct for no viable seed was present. The vigor and yield of the plants indicated that four generations of inbreeding had brought about no apparent degeneration. The fruits were quite uniform in shape and size and were so similar to the description already given of third generation fruit that no further description is necessary. Occasionally, a fruit showing a slight restriction of the neck was noted. In consideration of the persistent parthenocarpic character, together with the uniformity of the fruit and other plant characters, it was evident that this cucumber was as well, if not better, fixed than most of the commercial varieties.

In 1929, no bees were observed in the house in the early part of the season, and yet fruits without seeds developed freely. The fruits had approximately the same shape, size, and color as those of the third generation described above. A few fruits showed a tendency for a slight restriction at the neck. The uniformity of appearance again indicated that the characteristics of the cucumber were well fixed. Yield records were kept for each plant, but since many plants were selfed in order to obtain seed a publication of the results would give an unfair comparison. As seed production reduces yields (and this probably explains in part the higher yields obtained by the English forcing types), it may be rightfully assumed that the parthenocarpic habit of the Geneva is an asset to production.

The Hescrow during the first part of the season yielded much lower than any of the Station selections. Later its yields increased, and at the end of the test its production was on a par with the others. It is evidently later coming into maturity than the Geneva.

Some plants of different crosses made between selections in 1928 were included in the 1929 tests. As the plants and fruits of these crosses were practically identical with those of the strains selfed for three years, it is evident that the strains are pure lines and very similar in their constitutional makeup. Had they been otherwise a difference in the vigor and yield of the crosses would have been noted.

The cucumbers were marketed in 1929 at several local stores under the caption "Seedless Cucumber." Altho there was a good supply of American cucumbers in the stores during the experiment, the public paid over two and one-half times as much as it paid for the usual sorts and the Station had difficulty at times in satisfying the demand. This condition lasted during the whole period of the selling experiment which extended over about six weeks. As the cucumbers were not sold openly as coming from the Experiment Station, it was felt that the repeated buying on the part of the public was due solely to the merits of the cucumbers.

REPORTS OF OTHERS

During the season of 1929, a number of experiment stations grew the Geneva cucumber under test. Some favorable replies have been received. The Maine station³ reported that the Geneva proved to be the most popular with its trade in competition with Arlington White Spine, Improved Long Green, and an English forcing variety. It also yielded higher than the White Spine, but less than the English forcing type.

The color of the Geneva is the only character which has brought forth any unfavorable comment. This criticism is not universal as favorable opinions have been expressed. Actual marketing tests are the best criterion to determine whether the color interferes with marketability. The results of the above tests seem to answer any criticism on this score. Further tests, however, must be made on various markets before final judgment can be passed.

Many reported favorably on its yield, shape, and size. Its quality has everywhere brought forth praise. The flesh is white and thick and lacks the greenish color present so often in English cucumbers. The seed cavity contains only embryo seeds which never develop except when fertilized, hence the crisp, juicy, pleasant flavor of the fruit is not impaired.

³Test made under the direction of M. F. Babb.

THE FUTURE OF THE GENEVA

The work on this new cucumber has progressed to a point where its future depends on the commercial grower and the market which he supplies. Even should certain markets have no place for it, it is felt that quite likely certain ones do. The Geneva is unquestionably endowed with parthenocarpic properties, and since its characters are fixed, it should make a good cucumber for further breeding work. Darker strains may be more desirable and in future work at this Station this character will receive special attention. Parthenocarpic cucumbers save the grower the trouble of maintaining bees and should give higher yields, as the vine has no seeds to mature.

The Geneva cucumber represents selections from the fifth generation. The plants of this generation, even tho representing several previous selections, were so uniform that seed was collected from various plants. The seed from this fifth generation is being sent out for trial. Unfortunately, the seed supply is very limited and hence will be placed in the hands of interested commercial growers in this State. Requests for seed will be filled in order of receipt so long as the supply lasts. The Station solicits cooperation in a commercial test of this cucumber.