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General

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A BREEDING EXPERIMENT WITH TOMATOES.

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The extent to which plants may be modified by selection of seed, is of interest both to the practical cultivator, and the man of science. Few systematic experiments bearing upon this subject appear to have been reported. The one here given is not regarded as complete, but the results are thought of sufficient interest to merit presentation.

In the fall of 1883, seed was taken by the writer, then at the New York Agricultural Experiment Station at Geneva, from thoroughly mature fruits of the Cook's Favorite tomato, and at the same time from other fruits that showed no external indications of maturity. The latter fruits had nearly attained their full size, but had not commenced to change color toward ripeness. The following season (1884), plants were grown from both these selections of seed, and in the autumn, seeds were taken as before, i. e., from ripe fruits from the plants grown from ripe fruits, and from immature fruits from those grown from immature fruits. Plants were again grown from the two selections of seed in 1885, when seeds were again taken from the two strains as before, from which other plants were grown in 1886. From the latter crop, seeds were again saved, which were, however, not planted until the spring of 1889, when plants were grown from them at this Station, and the two strains have been continued up to the present time. We have therefore, one strain of the tomato grown through six generations from seeds known to be fully mature in every case, and another strain of the same variety, grown the same number of generations, from seeds taken from fruits that had not commenced to change color toward ripeness. The two

strains have been grown side by side throughout the experiment. What has been the effect upon the plants?

As a partial answer to this question, the reader is referred to the accompanying illustrations, which represent a plant of each strain; the first illustration being the strain from the mature seed, and the second the one from immature seed.

FIG. 11. Plant of Cook's Favorite tomato, grown six generations from fully matured seed.

FIG. 12. Plant of Cook's Favorite tomato, grown six generations from immature seed.

It appears clearly from the illustrations, that the use of immature seed has had the effect to very perceptably reduce the growth of the plant, and at the same time, to increase its prolificacy. But the illustration shows this truth but partially, as the following figures will testify. The foliage and stems of ten plants grown from the ripe seed the past season, from which the fruit had all been picked, weighed on September 21st, 149 pounds, while the same number

from the immature seed weighed but 65½ pounds. These ten plants from the ripe seed had matured up to September 19th, 1,298 fruits, weighing 57,127.2 grammes, while the ten plants from the unripe seed had matured at the same time, 2,519 fruits, weighing 102,376.6 grammes. The real difference in the growth and productiveness of the two strains will more readily appear from the accompanying diagrams.

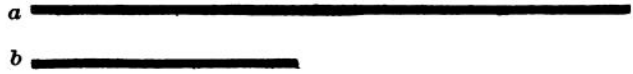

FIG. 13.—The comparative growth of stems and foliage (by weight) of plants grown from mature and immature seeds.—a, the plants from mature seed; b, those from immature seed.

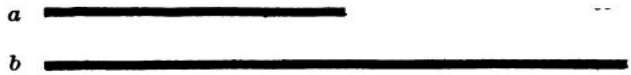

FIG. 14.—The comparative number of fruits that ripened up to September 19, on plants grown from mature and immature seed—a, plants from mature seed; b, those from immature seed.

The following diagram, Fig. 15, shows the comparative weight of these fruits:

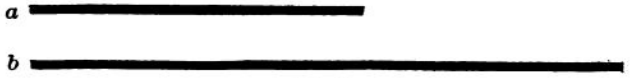

FIG. 15.

But these differences are by no means the only ones apparent in the two strains. The use of immature seed has clearly tended to *promote early maturity*, though the degree to which this influence has been manifest has not been uniform in different seasons. The first season (1884), the plants from unripe seed matured their first fruit 20 days in advance of those from the ripe seed, and they had matured ten fruits ten days in advance of the latter.[1] In 1885 the two strains ripened their first fruits on the same day, though the one from unripe seed matured ten fruits seven days in advance of the other.[2] In 1886, and in 1889, the dates of first maturity were not noted. In 1890, the strain from immature seed ripened its first fruit eight days, and 1 891 at

[1] Report N. Y. Agr. Expt. Station, 1884, 224.

[2] Ib. 1885, 209.

least fourteen days in advance of the other. Dr. J. C. Arthur, who grew the two strains at the Indiana Experiment Station, in 1890, secured a greater earliness of three weeks from the immature seed.[1] It thus appears that in the five trials in which the dates of first maturity were noted, the strain from unripe seed gave its first ripe fruit, on the average, 12.6 days earlier than the other strain.

The *size of the fruits* has been reduced slightly with the use of immature seed. Thus the fruits from the unripe seed averaged in weight 40.64 grammes, while those from the mature fruits averaged 44.01 grammes.

The *firmness* of the fruit from the immature seed has been somewhat less than that from the ripe seed, the rind being slightly thinner. A somewhat greater tendency to ripen unevenly has also been manifest, the fruit often being found slightly green at the center, when appearing quite ripe externally.

In *keeping quality*, the fruit from the immature seed has generally been inferior to that from the ripe seed, but the past season this difference scarcely appeared, both strains having kept remarkably well when picked from the plant. The fruit from the immature seed was, however, rather more subject to decay when left on the vines, and has always shown a greater tendency to crack after rain.

The *form of the fruit* has been very perceptibly affected, being rendered more oblate. Thus in forty typical fruits from the ripe seed measured the past season, the axial diameter was to the transverse diameter as 1 to 1.125, while in the same number from the unripe seed, it was as 1 to 1.313. Similar differences were noted in previous years.

The *number of cells* appears to have been affected. The forty typical fruits noted above from the ripe seed contained a total of 97 cells, while those from the unripe seed contained a total of 128 cells. A similar difference was noted by Dr. Arthur in 1890.[1]

The *tendency of the fruit to grow double* has increased with the use of immature seed. In the yield of ten plants

[1] Private letter.

from the mature seed, only two and one-half per cent. of the fruits that ripened between August 17 and September 19 were double; while in that of the same number from the immature seed, eight per cent. were double. Similar differences have been noted in previous years.

The *proportion of seed* to the weight of the fruit appears to have been affected. Five typical fruits from mature seed contained 2.64 seeds to the gramme of fruit, while six typical fruits from the unripe seed contained 3.35 seeds per gramme.

The *weight of the seed* appears to have slightly increased with the use of immature seed. The seeds from the five typical fruits noted above, from the plants from ripe seed weighed 2.743 grammes per thousand, while those from the six fruits from unripe seed weighed 2.804 grammes per thousand. Another sample of seed from the mature seed strain weighed 2.323 grammes per thousand, and a second from the unripe seed strain weighed 2.787 grammes per thousand. It should be remembered that these seeds were all from mature fruits.

The *posture of the plant* seems to have been rendered more decumbent by the use of immature seed, a fact noticeable throughout the experiment.

The *aspect of the foliage* has been affected in a conspicuous manner. The shade of color has been uniformly lighter in the plants from unripe seed, and the tendency to blight has been noticably greater in this strain. The surface of the leaflets has also assumed a much more blistered appearance in the plants from immature seed, than in those from ripe seed.

The *germinative power* of the unripe seeds has been uniformly very low. In 1884, seeds from a very immature fruit vegetated but 2 per cent., while seeds from a ripe fruit in the same trial vegetated 96 per cent. The immature seeds planted in the spring of 1891, tested in the Geneva apparatus, showed a germination of 31 per cent., while the ripe seeds germinated 99.5 per cent. In three trials, the weight of the immature seed was found to be somewhat less than

that of mature seed. This was true whether the mature seed came from a plant grown from ripe, or unripe seed.

The *percentages of water and of ash* contained in the plants appear to have been affected, a decrease in the water content, and a corresponding increase of ash having been found in the plants from the unripe seed.

Another experiment that has been carried on as a companion to the one just described may be mentioned here. In the fall of 1883 a single plant in a row of the Little Gem tomato, a variety bearing a considerable resemblance to the Cook's Favorite, was observed to be much more feeble in growth and to have a larger percentage of decayed fruits than any other plant in the row. The fruits of this plant showed it to be the true Little Gem, and yet its habit and the appearance of its foliage indicated that it was not in a normal condition. In the hope of finding a clue to the cause of this feebleness, seeds were taken from some of the sound fruits from the feeble plant, and also from one of the other plants that was apparently in perfect health. The two samples of seeds were planted the following spring, and the two strains have been continued as in the preceding experiment, with the exception that after the first two seasons, the seeds of the feeble strain were taken from decayed, instead of from sound fruits. It is of interest that whatever the cause of the feebleness of the original plant as noted in 1883, the characters then observed have been faithfully maintained throughout the six generations. The feebleness appeared to increase during the first three plantings, but this has not been true of later plantings. What is more to the present purpose, the changes noted in the preceding experiment as accompanying the use of immature seed have been almost exactly duplicated in this instance. Whether or not the feebleness of the Little Gem plant, that served as the starting point of our second experiment, was due to the plant having been grown from immature seed, is not known. If it was, the second trial serves as a duplicate to the first. If it was not, the second experiment still has value, because it suggests that the changes that accompanied the use of immature seed may be due, primarily, to

a reduction of vigor, and would result from any cause that tends to reduce the vigor of the plant.

It may be added that there is no good evidence that the changes noted as accompanying the use of immature seed, or seed from the enfeebled plant tend to increase in degree as the plantings are continued. During the first three generations the feebleness of the feebler strains appeared to increase with each planting.[1] But this has not been true of later plantings. Indeed, during the past two seasons, the strain from unripe seed has appeared to slightly increase in vigor.

What practical lessons may be deduced from these experiments?

1st. The results suggest that in our climate, the tomato, at least its more rampant growing varieties, may be rendered more productive and earlier in maturing by a treatment that reduces the native vigor of the plant. Growing the plants on rather poor and dry soil, pinching the growing points, or root pruning should accomplish this end.

2nd. The health of plants is in a degree dependent upon the quality of the seed used. In these days of severe competition in the seed trade, dealers are doubtless often tempted to use immature or otherwise unsuitable stock for seed. The popular demand for cheap seeds tends to deteriorate quality in this commodity, and consequently in our crops, and to render the latter more subject to disease.

It must not be understood that the use of immature tomato seed is sanctioned or recommended in this article. The experiment is not as yet complete, and it is too early to announce its full teachings.

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[1] See Report of New York Agricultural Experiment Station, 1886, 169.