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WEST VIRGINIA UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
MORGANTOWN, W. VA.

BULLETIN 117

JUNE 1, 1908.

TOMATO NOTES

This bulletin contains notes upon the history of the tomato; the development of modern forms; breeding new varieties; field culture; tomato growing in winter; and financial returns.

[The Bulletins and Reports of this Station will be mailed free to any citizen of West Virginia upon written application. Address Director of Agricultural Experiment Station, Morgantown, W. Va.]

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TOMATO NOTES.*

W. M. MUNSON.

Next to the potato, the tomato stands, perhaps, at the head of the list of garden vegetables in commercial importance. In Maryland, New Jersey, Delaware, Ohio, Indiana, and to a rapidly increasing extent, in West Virginia, the crop is of special importance; while the greenhouses of New York and New England, and the newly developed truck fields of Florida, endeavor to supply the demand for this fruit in winter.

By far the larger portion of the area devoted to this crop is employed in supplying fruit for the canning factories, and it is the demand of the canneries which, more than any other, has given the great impetus to tomato culture. The credit of introducing canned tomatoes as an article of trade, is due to Mr. Harrison W. Crosby, who made his first venture in 1848, while steward of Lafayette College, Easton, Pennsylvania. There was a ready demand for the goods and, with increased supply and improved machinery, the cost has been reduced from 50 cents per can in 1848 to 7 cents at the present time. With this reduced cost, the output of the factories has increased to an almost incredible extent. The total output of the United States, for 1887, was about 3,000,000 cases, of 24 cans each. In 1894, the output was nearly doubled; while in 1904 the

* The tomato has been a crop of special interest to the writer of this bulletin for more than 20 years, and during that time various notes and observations have been published. Most of these observations were made in connection with the work of the Cornell University, and the Maine Agricultural Experiment Station; hence the frequent references to bulletins of those stations in the present discussion. At the request of the Director of this Station, and because of the value of this crop to the state, special attention will be given to its requirements and development.—W. M. M.

9,000,000 mark was reached, and in 1907 the pack reported was approximately 13,000,000 cases. There are no separate data for West Virginia, but for Virginia and West Virginia, the estimated pack for 1907 was approximately 1,000,000 cases.¹

HISTORY AND CLASSIFICATION.

The garden varieties of tomatoes belong to two distinct species: *Lycopersicum pimpinellifolium*, Duval, and *Lycopersicum esculentum*, Miller. The former is represented in the garden by the "Currant" or "German Raisin," and is of weak, spreading habit, with small thin foliage and delicate flowers, arranged in two ranks on a long raceme. The whole aspect of the plant is delicate, and the long racemes of fruit are not unlike large clusters of currants. This species is found wild in Peru and Brazil, but little is known of its history. It has not been modified by domestication; and probably has not been long under cultivation. The chief value of this species, aside from its use as an ornamental plant, and to a limited extent for preserves, is in breeding new types. Some work in this direction has been done by the writer;² also by Bailey and others at the Cornell University Experiment Station.³ The resulting hybrids are very unstable, however, and, as a rule, the fruit is too small to be of commercial importance.

Lycopersicum esculentum, the ordinary tomato, is undoubtedly a native of Peru, but is spontaneous or indigenous throughout Mexico and as far north as Texas and California, in a form closely approaching the Cherry tomato of the gardens. It was probably first cultivated in the south of Europe, where it is mentioned as early as 1561.⁴ In 1583 the "fruit was eaten upon

¹ Am. Grocer.

² Ann. Rept. Maine Expt. Sta., 1892, pp. 65-69.

³ Cornell Univ. Expt. Sta. Bul. 32, p. 165.

⁴ Anguillaria, Simp., 217.

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TOMATO GROWING IN WINTER. (See page 259.)

the continent, dressed with pepper, salt and oil.”⁵ It was grown in England in 1597,⁶ but for many years was used only for ornament. In 1700 Tournefort⁷ mentions 7 varieties, one of which was pale red, one striped, two yellow, one white, and two red; but the culture was still neglected, for more than 100 years later, in 1819, only 4 red varieties are mentioned, and the pale red sort is not named.⁸

Our own country was much later even than England in taking up the general culture of the tomato. The fruit is said to have been introduced into Philadelphia by a French refugee from San Domingo, in 1798.⁹ In 1806, McMahon writes:¹⁰ “The tomato is much cultivated for its fruit in soups and sauces * * * and is also stewed and dressed in various ways and very much admired.” It was introduced into Salem, Massachusetts, about 1802, by an Italian painter, Corne, “but he found it difficult to persuade the people even to taste the fruit.”¹¹

The tomato began to be cultivated for market in this country about 1829, but not until 1839 was it mentioned in the premium lists of the leading horticultural societies.¹²

DEVELOPMENT OF THE MODERN TOMATO.

The original wild type of the garden tomato was probably, as suggested by Bailey,¹³ very similar to the Cherry tomato of

⁵ Dodonæi Stirp. Hist., 455.

⁶ Gerarde, Herball, 275.

⁷ Inst. Rei. Herb. 1, 150.

⁸ Trans. Lond. Hort. Socy., III, 347.

⁹ Manning, Hist. Mass. Hort. Soc., 40.

¹⁰ McMahon Gard. Calendar, 319.

¹¹ Felt, Annals of Salem II, 631; cited by Manning, Hist. Mass. Hort. Soc., 40.

¹² Manning, Hist. Mass. Hort. Soc., 40.

¹³ Am. Naturalist, June, 1887, 573; also Bul. 31, Mich. Agr. Coll. The exhaustive study by Bailey of the evolution of the tomato is the best published, and I draw freely from his discussion without further credit.—W. M. M.

the present day. The tomato, however, is of exceedingly variable habit, and is readily susceptible to the influence of selection. Its variability lies mainly in size, form, and number of cells. In nature there is usually a definite number of cells in the fruit of any given species, but one of the first effects of cultivation is to render this character inconstant. In the wild tomato there are normally 2 cells; in the cultivated varieties, almost as many different forms and combinations of cells as there are individual fruits. "The effect of cultivation has been to increase the size of the fruit by the interposition of new cells, this condition resulting in the angular shapes characterizing many of the garden forms. In other words, the modern large fruited and irregular sorts have been developed, first, by the augmentation of cells in the primitive type, and later by the modification of the flower and the production of an abnormal number of parts."¹⁴

The history of the introduction of the well known garden varieties, is of recent date. The old "Large Red," of the earlier catalogs, was followed in 1862 by Fiji Island and in 1869 by the Cook's Favorite. In 1866 Tilden appeared, and then in rapid succession Maupay, Keye's Extra Early, Boston Market, General Grant, Trophy and Paragon.

Paragon, the first of the many good varieties originated by the veteran tomato breeder A. W. Livingston, of Columbus, Ohio, was a marked step in advance over all former introductions. It was really the first of the round or apple shaped varieties to attain prominence, and gave a great impetus to the tomato as a field crop. It was a triumph for the application of correct principles of selection, for, in the production of this variety, the habit of the whole plant rather than the character of an individual fruit was considered.

In 1880, Perfection, another of Livingston's selections, appeared; and during the next 10 years, Favorite, Beauty, Dwarf Champion, Lorillard, Ignotum, and a host of less worthy sorts

¹⁴ Bailey, *loc. cit.*

followed. Dwarf Champion was the first of the short jointed, thick leaved varieties to attain prominence; Lorillard, introduced in 1887, marked the special development of tomato growing under glass; Ignotum, originated at the Michigan Agricultural College and first cataloged in 1890, was specially noted for its large, smooth, meaty fruit, and marked the highest development of the tomato at that date.

Since 1890, Stone, Ruby, Aristocrat, and a host of other new varieties have appeared, but, except that some of the very early sorts have developed a smoother type of fruit, little real advance has been made in the commercial sorts. Each year, however, sees its addition to the list of commercial varieties offered for sale.

BREEDING NEW VARIETIES.

The production of new varieties of tomatoes has, in the main, been a work of selection from "sports," or chance seedlings, of special merit in some one direction. At the Maine Experiment Station, and also at Cornell University, some attention has been given to the production of hybrids between the two species but, as already noted, (page 252), these hybrids are as a rule small, and the resulting type is unstable. As the result of several years of crossing and selection, the writer succeeded in producing a type which was well adapted to use under glass.¹⁵ The fruit of this hybrid was too small for general field culture, however.

Crosses between Ignotum and Peach, also between Lorillard and Peach,—the latter an early and very productive sort which, however, is too soft for market—resulted in a marked increase in the number of fruits maturing before frost but with a considerably reduced size; and in the second and third generations

¹⁵ Ann. Rept. Maine Agr. Expt. Sta., 1892, p. 68; also *Ibid*, 1894. p. 28, with Plates I. and IV.

the effect upon the earliness of the crop was much less noticeable.¹⁶

Attempts have been made to produce yellow fruits with a blush cheek by crossing red fruited and yellow fruited types. As a rule, however, no satisfactory results have been obtained. In the writer's experience, the plants resulting from this cross invariably produced red fruits. One variety of this type, "Lemon Blush," was listed by a prominent seedsman; but, as grown in northern latitudes, the blush failed to appear. By continuous selection from Golden Queen, there was produced in the forcing houses of the Maine Experiment Station a type of this variety with distinctly blush cheek; but as grown in the field, this characteristic disappeared.

The importance of the character of the plant, rather than of the individual fruit, in selecting for new varieties or for general crop, is a matter of general observation. The importance of this factor in breeding was emphasized by the results obtained at the Cornell University Experiment Station.¹⁷ "Two lots of tomatoes, (Volunteer, being the variety used), were grown under like conditions. One lot was from commercial seeds, and was in every way typical of the variety. The other lot was grown from seeds obtained from a small inferior fruit (only $\frac{3}{4}$ inch in diameter) which was taken from a plant bearing mostly large fruits. The yield from the first lot—commercial seeds—previous to frost, was 6.7 lbs. per plant, with an average weight per fruit of 5.3 oz. The yield from the second lot was 8.8 lbs. per plant, with an average of 7.3 oz. per fruit. Similar results were obtained with the Mikado." In this way, by selecting individual plants in a field, smoother varieties; earlier, more productive or better types are produced.

That varieties "run out," or lose their distinguishing characteristics, is beyond question. With careful selection on the

¹⁶ Ann. Rept. Maine Agr. Expt. Sta., 1892, pp. 65, 66; 1893, pp. 115, 116.

¹⁷ Bailey and Munson, Cornell Univ. Expt. Sta., Bul. 21, p. 75.

part of the grower, however, a given type may be preserved for many years. "Running out" does not necessarily mean deterioration. A variety may be developed into a decidedly improved type, by attention to seed selection; as has been the case with Trophy, Mikado, Ruby, and some other very angular sorts.

CULTURAL NOTES.

Certain of the more salient points in the field management of this crop, which have received the writer's attention during a somewhat extended study, are considered in this connection.

One of the most important problems in tomato culture is that of earliness. As a rule, plants purchased of the local dealers are drawn and "leggy," being crowded together in small boxes. When set in the field, where, too often, the soil is hard and dry, the shock is such that several weeks are required for the plants to recover, and no fruit sets until late in the season. In general, these weak drawn plants are not worth setting.

Frequent transplanting before setting in the field is the best method of securing strong, stocky, well developed plants. The practice usually followed by the writer has been to sow the seeds in hot beds, or in shallow boxes in the greenhouses, about April 1. When the first true leaves have well started, or as soon as the plants begin to crowd, transfer to 2-inch pots, and later to 3-inch and 4-inch if occasion demands. As a rule, however, in this climate, it will be unnecessary to handle the plants more than twice. In the absence of pots, the plants may be handled in boxes, or even in the bed; but pot-grown plants are always preferable, as they are checked less by removal to the field. In the field, the plants are set about 4x5 ft. Many would plant closer, but on reasonably rich ground the plants will cover the whole surface if set at this distance.

The plants should be set in the field as soon as danger from frost is past. It has commonly been taught that any chill is nearly fatal to young tomato plants; but, as shown by the

writer's work at Cornell University,¹⁸ and at the Maine Experiment Station, "a chill is not as fatal to success as is commonly supposed."¹⁹ At the Maine station it was found that, "in every instance, save one, the first ripe fruits were obtained from plants set latest. This fact, however, is not necessarily an indication of earliness, as the late set plants were older than is usually desirable for setting, and the first fruits were in some cases from blossoms formed while in the house. After these had ripened, there was a long interval before others followed. "Without exception, the average number of fruits, and the average weight of the product, per plant, was in direct ratio with the earliness of setting."²⁰ These facts are in direct confirmation of results obtained in the two preceeding years.

The question of fertilization was touched upon in Bulletin 116, of this Station. As there stated,²¹ the notion that tomatoes do better upon relatively poor soil, is erroneous. While it is doubtful if an excessively heavy application of stable manure would be profitable, a liberal application, such as would be given for a good crop of corn, may nearly always be used with advantage. At the Cornell Experiment Station it was found that, "the results obtained with liberal manuring, under commercial conditions, * * * certainly show that good stable manure in abundance could be used profitably."²²

Some of the best tomato soils are the newly cleared areas designed for orchard planting. But on these same new soils, an application of about 500 lbs. of a good high grade complete fertilizer will usually be found advantageous.

Trimming the vines, in midsummer, as a means of hastening maturity and increasing the yield of fruit, is frequently recommended, but very seldom practiced, even by amateurs. In

¹⁸ Cornell Univ. Expt. Sta. Bul. 21, p. 79.

¹⁹ Ann. Rept. Maine Agr. Expt. Sta., 1892, p. 62.

²⁰ Ann. Rept. Maine Expt. Sta., 1892, p. 63.

²¹ Bulletin 116, W. Va. Agr. Expt. Sta., p. 221.

²² Cornell Univ. Expt. Sta. Bul. 21, p. 78.

the writer's experience the results obtained justify greater emphasis of this point. As a result two of successive season's work, at the Maine Experiment Station,²³ it was found that the total increase in the number of fruits matured, due to trimming, ranged from 5.5 per cent to 50 per cent. The percentage gain by weight, was very marked and in one instance reached a total of 58 per cent. In these trials, the plants were grown under ordinary field culture. They were started in the greenhouse April 1; planted in the field June 1; and headed back July 24, August 8, and September 5. At each trimming the leading branches were shortened about 6 inches, and most of the side shoots below the first clusters of fruit were removed, the others being shortened. The sunlight was thus freely admitted to the fruit, and picking was rendered much easier.

TOMATO GROWING IN WINTER.

Successful tomato culture under glass, depends as much upon the man in charge as upon conditions. Eternal vigilance and the exercise of good judgment on the part of the grower are more essential than strict adherence to set rules. The crop is one which demands constant care and intelligent management, but under suitable conditions the returns are very satisfactory; and the product meets a ready demand at good prices.

The most important conditions for forcing tomatoes are: A warm light house—one having a two-thirds span facing the south being preferable—strong bottom heat, rich soil, careful training, uniform temperature, care in watering and pollinating, and, as before suggested, good judgment and constant watchfulness on the part of the grower. Bottom heat is not absolutely essential to success, but the crop matures more quickly if given this condition.

To make the best use of the house, two crops should be grown during the season. This will bring each crop on at a

²³ Ann. Rept. Maine Agr. Expt. Sta., 1891, p. 89.

season when the expense of heating, during a part of the time, will be slight. Plants for the first crop should be started as early as the first of August. If two or more houses are available, a second sowing should be made in about 3 weeks, to give a succession. For the second crop, seed should be sown during the latter part of October.

The plants are treated in every way as for out-door culture till handled the last time. For fruiting, some prefer benches, with about 6 inches of soil; but, in the writer's experience, the best results have been obtained from the use of boxes 18 inches square and 12 inches deep.²⁴ In the bottom of the boxes is placed a layer of charcoal, broken pots, or "clinkers" from the furnace; after which soil, consisting of 3 parts good garden loam and 1 part well rotted stable manure, is filled in to within 2 or 3 inches of the top. Each box will hold 4 plants, and the check caused by the partial confinement of the roots seems to be of value in hastening maturity. If the solid bed is used, instead of the boxes, the plants are set about 16 inches apart each way, thus occupying a little more than 1½ square feet of floor space, for each plant.

Best returns usually follow where the plants are trained to a single stem, as shown in plate 2. Flax cords, about the size of wool twine, are fastened to the corners of the boxes, or to wires placed parallel to each row, for that purpose, and attached above to wires running lengthwise of the building, on the rafters or sashbars. The plants are secured loosely to this support by means of short pieces of raffia. All side shoots should be pinched out as soon as they appear; and when the plants are about 5 feet high, or when 4 clusters of fruit have set, the terminal buds should be pinched off. The vitality of the plant will then be expended in the development of fruit. If the plants are not headed back, other fruit clusters will form, but these scattering later clusters will unduly prolong the fruiting season without giving sufficient financial return to warrant delaying the removal of the old plants.

²⁴ Ann. Rept. Maine Agr. Expt. Sta., 1894, pp. 58-60.

SINGLE-STEM TRAINING. (See page 260.)

As the fruit sets, the clusters should be supported by means of a small cord or piece of raffia passing around the main stem above a leaf, thus forming a sling. At this time, too, it is well to stir the surface of the soil, and work in a quantity of well-rotted manure, or to give frequent applications of liquid manure.

The temperature of the house should be as nearly uniform as possible,—about 60° at night and 70° in dark weather, but 80° or even higher on bright sunny days. All cold drafts and sudden changes of temperature should be rigidly avoided.

FINANCIAL RETURNS.

The writer's experience in forcing tomatoes, is limited to New York and New England, where, owing to the low temperatures and the excessive number of dark cloudy days, the yields were not large. In Maine,²⁵ the yield per plant, with the best forcing varieties, was 2½ to 3 lbs. In New Jersey the average yield reported is somewhat larger. On the basis of 3 lbs. per plant, however, the returns at 30 cents per pound, or 25 cents at wholesale, are very profitable; being about 50 cents per square foot of bench space, for each crop. Of course these figures can not always be relied upon, for unforeseen conditions frequently arise; but, on the other hand, the experienced gardener will, by the use of other crops, as lettuce, radishes and cucumbers, utilize the space in the house so as to provide against these unforeseen factors.

The average yield per acre, as grown for the canneries, is 125 to 150 bushels. The man who makes a specialty of tomatoes however, will not be content with less than twice the amount named. It is better to cultivate fewer acres and cultivate them well, than to attempt to cover too much ground. Even at 200

²⁵ Ann. Rept. Maine Agr. Expt. Sta., 1894, p. 62.

bushels per acre, however, the returns will be far greater than can be derived from wheat, corn, or other farm products.

No attempt is made, to exert undue influence, by citing special instances of large crops or of large prices. As a simple business proposition, however, tomato growing offers excellent opportunities at this time.