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PORTO RICO AGRICULTURAL EXPERIMENT STATION,

D. W. MAY, Agronomist in Charge,

Mayaguez, P. R.

Bulletin No. 20.

EXPERIMENTS ON THE SUPPOSED DETERIORATION OF VARIETIES OF VEGETABLES IN PORTO RICO, WITH SUGGESTIONS FOR SEED PRESERVATION

BY

C. F. KINMAN,
Horticulturist,

AND

T. B. McCLELLAND,
Assistant Horticulturist.

UNDER THE SUPERVISION OF
STATES RELATIONS SERVICE,
Office of Experiment Stations,
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PORTO RICO AGRICULTURAL EXPERIMENT STATION.

[Under the supervision of A. C. TRUE, Director of the States Relations Service, United States Department of Agriculture.]

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LETTER OF TRANSMITTAL.

PORTO RICO AGRICULTURAL EXPERIMENT STATION,
Mayaguez, P. R., October 19, 1915.

SIR: I have the honor to submit herewith a manuscript on Some Experiments on the Supposed Deterioration of Varieties of Vegetables in Porto Rico, with Suggestions for Seed Preservation, by C. F. Kinman, horticulturist, and T. B. McClelland, assistant horticulturist.

This paper gives the results of several years' study on the question of the supposed deterioration of varieties of vegetables when grown through several generations in the Tropics. The information contained herein should be of great benefit, not only in Porto Rico, but throughout the Tropics generally, or wherever similar conditions exist. In connection with these investigations it was found that the season of planting affected the yield and character of vegetables to a remarkable degree. The data presented will, it is believed, go far toward developing vegetable growing, an industry that is greatly neglected in Porto Rico.

Vegetable seeds of all kinds deteriorate rapidly in the hot, moist atmosphere of the Tropics, and a method has been developed whereby the viability of seed can be retained for a much longer period than is possible under normal conditions. This information will doubtless prove valuable to seedsmen and planters generally.

I respectfully recommend that the manuscript be published as Bulletin No. 20 of this station.

Respectfully,

D. W. MAY,
Agronomist in Charge.

DR. A. C. TRUE
Director States Relations Service,
U. S. Department of Agriculture, Washington, D. C.

Recommended for publication.
A. C. TRUE, *Director.*

Publication authorized.
D. F. HOUSTON,
Secretary of Agriculture.

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INTRODUCTION.

Vegetable gardening in Porto Rico is a small industry and one in which there has been little progress for many years. Aside from the culture of tomatoes, okra, beans, pigeon peas, and starchy root crops, which are grown as horticultural crops, the farm garden is seldom seen. The commercial gardens are few and small and devoted to the culture of few vegetables, these often of inferior type. The poor development of the vegetable industry results from the unfavorable soil and climatic conditions, a lack of knowledge regarding the value of the best varieties and concerning good seed and its storage, and the production of seed at home. There is a belief that northern-grown vegetables degenerate quickly in Porto Rico and that the seed from even the first generation produces plants which are inferior to their parents. This belief results partly from the common practices in vegetable growing. On account of the heavy summer rains, the crops which are grown from seed are for the most part planted in the fall or winter. If seed harvested from these plantings is immediately sown, the plants as a rule give poor results, as they must contend with heavy rains, intense heat, and other unfavorable conditions. The unsatisfactory development and yield of the plants are naturally but unfairly attributed to the rapid degeneration of the seed resulting from the effect of the tropical climate.

Because of the high humidity, seed deteriorates rapidly in the Tropics if exposed to the open air, and, therefore, much of the seed offered for sale by local dealers is almost valueless. Imported seed is often several months old when it arrives here, and it soon loses its viability, leaving the home product to supply the demand. The defective methods employed in collecting, curing, and storing seed render much of the seed harvested in winter useless for planting the following winter, and seed produced during the rainy season, when seed production is very low, often must supply the demand.

In 1910 experiments were undertaken to determine the degenerating influence of the climate of Porto Rico on the growth and productiveness of a few garden crops imported from the North. During the progress of the work, observations have also been recorded regarding seasonal effects on the production of different plants, methods for storing seed, and tests made to ascertain the period of viability of seed imported from the North and of seed grown in Porto Rico. The results of this work should prove valuable in changing the common belief and practices which have practically stopped progress in the culture of some vegetables.

PRACTICES FOLLOWED IN THE EXPERIMENTS.

In undertaking this work seed of a number of common garden vegetables, including tomato, pepper, okra, beans, lettuce, radish, beet, squash, and cantaloup, which had been grown in the North, was imported. When the seed first arrived, a portion of it was placed in closed jars which were kept dry by placing in the bottom a few ounces of calcium chlorid. (See fig. 8, p. 27.) The seed treated in this way remained in first-class condition until the experiment was concluded or until the seed was exhausted by planting or testing otherwise.

Throughout the experiment, the crops were grown in the open field under normal field conditions, and on a site very similar to those employed for gardens in the vicinity. This field is in an almost level valley where the soil is a heavy dark loam which is fairly fertile, but has little vegetable matter and poor subdrainage. To avoid damage from surface moisture and to insure soil aeration, the land was well stirred, and raised beds with a space of 1 foot between them, were made just previous to each planting. As plantings of each successive crop could not be made in the same place, there was danger of influencing the yield by soil variation between the different plats, although all the land used for the experiment was apparently very uniform. To overcome as much as possible any variation in the soil fertility, a heavy and uniform application of fertilizer was given each crop. The fertilizer contained 3 per cent nitrogen, 9 per cent phosphoric acid, and 10 per cent potash. It was applied at a rate slightly in excess of 1 ton per acre. In addition, a uniform dressing of stable manure was given the beds. The nitrogen in the form of nitrate of soda was applied after the plants were well established. The quantity of fertilizer was intended to be in excess of the needs of the plants so as to prevent minor differences in the natural soil fertility of the different plats influencing the growth of the plants. This would make the climate responsible for the growth and productiveness of the plants of different generations. As the imported seed and seed from succeeding generations were planted in beds which were side by side, the variation in soil conditions could have had little influence on the yield.

In order to eliminate as far as possible the factor of varying weather conditions, simultaneous plantings were made of as many different generations as possible.

Care was taken that the crops should not degenerate nor be improved by seed or plant selection or by crossing with other varieties. At the time of planting a much larger number of seed was sown than the number of plants desired for the experiment. The young seedlings were later thinned, leaving the desired number of plants of average size and vigor. Where there was danger of blossoms being fertilized from other varieties, the blossoms which were to produce seed for future plantings were hand-pollinated and bagged.

The term season in this discussion is used with reference to periods of rain and drought, as the temperature in Porto Rico varies by only a few degrees throughout the year and is always conducive to the growth of vegetation. The seasons of rain and drought and the rainfall for the different months during which the experiments herein considered were in progress are shown graphically in figure 1. By comparing the rainfall and the production of the crops included in this experiment it will be seen that the variation in the amount of rainfall in different months is probably responsible for much of the variation in yield between different times of the year and therefore must be considered in calculating the results of the harvests. As the rainfall varies considerably in different localities in Porto Rico, the results secured with reference to the effect of climate on the production of vegetables are applicable to sections where the distribution of rainfall throughout the year is similar to that at Mayaguez.

The results which were obtained during the few years' work with vegetables are given below in detail.

In order that the system of naming may be understood, a word of explanation is necessary. Each planting of northern-grown seed is denoted by a Spanish ordinal number, as Primera, Segunda, Tercera, indicating the first, second, and third plantings, followed by 1st, indicating first generation or northern seed. In each instance the plants raised from seed of these plantings bear the same Spanish ordinal as the parent planting, followed by 2d, indicating the generation, and so forth, lineal generations being always denoted by the same Spanish ordinal. In some instances several plantings other than first generations were made from the same lot of seed. These are distinguished by letters following the English ordinal.

RECORDS OF THE CROPS.

After the work had been in progress for only a short time it was seen that a few of the vegetables included in the experiment were not suited to the work, as climatic and soil conditions were not favorable

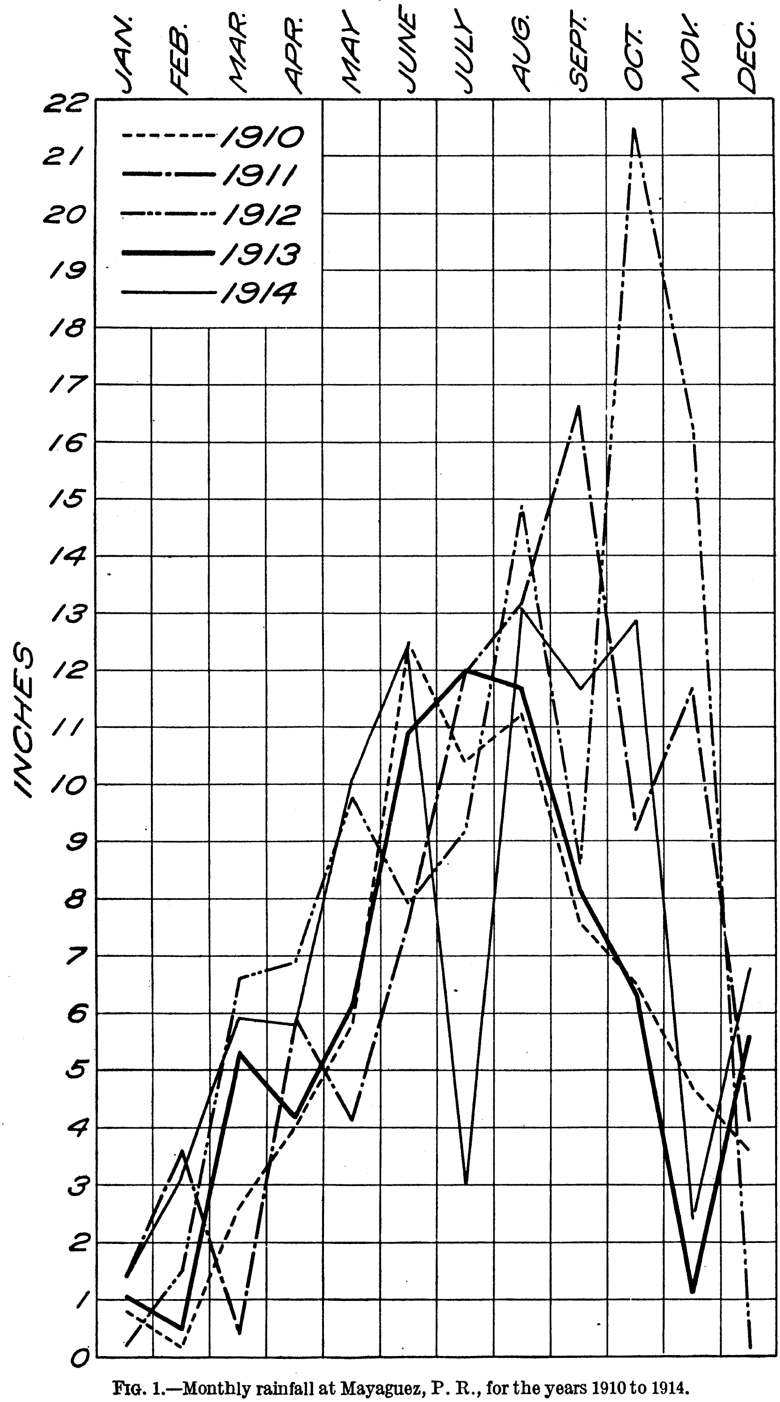

FIG. 1.—Monthly rainfall at Mayaguez, P. R., for the years 1910 to 1914.

to seed production. Cantaloups and squash were not grown after the first season on account of troublesome insects and weather conditions, which cause a very poor yield and would probably influence results by the necessity of planting, at least from later generations, seed which was not from average and representative plants and fruits. Beets and radishes were not grown beyond the first generation, as attempts to produce seed failed. The leaves and roots made a thrifty growth, but the plants all died without sending up seed stalks. While these plants occasionally produce seed in Porto Rico, the crop is so uncertain and the yield so small that for the present at least it is necessary to import the seed required for these crops.

With peppers the Ruby King variety was planted, but it was impossible to get data of size and weight of fruits, as they were nearly all attacked by rot before they matured. The plants grew poorly and produced such a small crop, as compared with the kinds commonly grown throughout the island, that it was apparent that seed of this type of peppers should not be imported. Further tests were made, however, to compare the growth and yield of the types commonly grown in Porto Rico with those of a number of similar imported varieties, including Ruby King, Chinese Giant, and Tabasco, to determine the advisability of producing seed from them. Plantings of these varieties were made in the spring when the weather favored a good plant growth, but later the rainfall was so heavy that conditions were unfavorable for growth and blossoming. The imported varieties made a rapid growth at first, but before fruit matured, the leaves began to fall, and the plants became barren stalks which did not regain their vigor. The average production per plant of Ruby King and Chinese Giant was between three and four marketable fruits, and that of Tabasco was small also. The growth of all the common Porto Rican types was vigorous from the first, and they continued thrifty and productive for several weeks after the northern varieties were dead, their average production being over 16 fruits per plant. The fruit from the common Porto Rican type resembled very closely in size and shape the best northern kinds and was not inferior to them in flavor. The types tested included both sweet and pungent varieties.

As the ancestors of the seed imported from the North for this test were doubtless taken from tropical America many years ago, these results show that the marked change effected by acclimatization and selection to suit northern conditions resulted in rendering them unfit for tropical conditions. Results with other crops discussed here show that where seed or plant selection is not practiced the place effect on these crops is too slow to be of importance to gardeners.

BEANS.

The beans were of the Extra Early Valentine bush variety, grown in New York for J. M. Thorburn & Co., of New York City, and obtained in February, 1910. All plantings were made from this importation except Segunda, which came from seed received September, 1911, and Octava, Novena, and Undecima, from seed received January, 1913.

The seed was planted in two parallel rows about 6 inches apart and 25 feet long. Each bed was thinned to 130 to 135 plants. In some instances weather conditions retarded germination, and some plants did not appear until after the thinning, which usually took place within two weeks after planting, thus making a few more plants than the experiment called for. In other instances disease entered and reduced the number of plants after thinning to a number below the average of the experiment. The results of these plantings are shown in Table I.

TABLE I.—*Bean generations.*

Date of planting.	Name.	Number of producing plants.	Number of days from planting until blossoming.	Average number of pods per plant.	Average number of beans per pod.	Average number of beans per plant.	Number of beans contained in ½ liter.
Porto Rico plantings.							
Mar. 12, 1910	Primera 1st	137	32	9.31	3.34	31.1	[1] 1,411
Sept. 17, 1910	Primera 2d	61	31	3.02	2.64	8.0	....
Dec. 24, 1910	Primera 3d	137	35	6.03	2.78	16.8	[1] 1,559
Mar. 11, 1911	Primera 4th	126	37	5.97	2.24	13.4	[1] 1,412
Sept. 16, 1911	Segunda 1st	112	30	4.22	2.61	11.0	[1] 1,994
Do	Tercera 1st	127	30	4.48	2.61	11.7	[1] 1,966
Do	Primera 5th	124	31	4.99	2.29	11.4	[1] 1,862
Dec. 22, 1911	Cuarta 1st	148	36	3.57	2.13	7.6	1,420
Do	Tercera 2d	131	36	2.88	1.97	5.7	[1] 1,693
Do	Primera 6th	138	36	3.91	2.19	8.6	[1] 1,443
Mar. 12, 1912	Quinta 1st	127	32	11.17	3.21	35.9	1,268
Do	Cuarta 2d	135	34	10.78	3.18	34.3	1,226
Do	Primera 7th	131	34	11.99	3.21	38.5	1,226
Jan. 17, 1913	Octava 1st	127	34	5.10	2.60	13.3	1,610
Do	Minn. A 1st	116	34	6.12	2.78	17.0	1,560
Do	Minn. B 1st	103	34	5.12	2.56	13.1	[1] 1,455
Do	Minn. C 1st	119	35	5.17	2.64	13.6	1,512
Nov. 8, 1913	Novena 1st	86	35	2.73	2.02	5.5	....
Do	Decima 1st	117	34	2.26	2.01	4.5	....
Do	Quinta 2d B	57	35	2.79	2.08	5.8	....
Do	Octava 2d	73	35	1.86	1.76	3.3	....
Do	Minn. A 2d	88	34	2.19	1.91	4.2	....
Do	Minn. B 2d	84	34	2.11	1.84	3.9	....
Do	Minn. C 2d	88	35	2.01	1.67	3.4	....
Do	Primera 8th B	95	35	2.22	2.10	4.7	....
Mar. 26, 1914	Undecima 1st	53	32	11.89	2.98	35.4	1,230
Do	Duodecima 1st	73	32	10.21	3.23	33.0	1,302
Do	Novena 2d	84	32	8.64	3.28	28.3	1,213
Do	Decima 2d	95	32	8.58	2.91	25.0	1,228
Do	Quinta 3d	71	32	9.51	3.03	28.8	1,273
Do	Octava 3d	77	32	9.10	2.52	22.9	1,234
Do	Minn. A 3d	79	32	8.14	3.05	24.8	1,268
Do	Minn. B 3d	71	32	9.80	3.20	31.4	1,264
Do	Minn. C 3d	90	32	9.30	3.15	29.3	1,205
Do	Primera 9th	79	32	9.22	3.18	29.3	1,238
Minnesota plantings.							
June 1, 1912	Sexta 1st	137	....	14.67	3.41	50.0	1,009
Do	Quinta 2d A	145	....	12.10	3.41	41.2	1,080
Do	Primera 8th A	146	....	12.79	3.41	43.6	1,[illegible]11

[1] Estimated.

The first planting of beans, Primera 1st generation, was made March 12, 1910. The season was quite favorable for this crop, and the yield per plant averaged 9.31 pods of 3.34 beans each, or 31.1 beans per plant.

From this crop two plantings were made during the following June. The first, made on June 11, was removed on account of injury from an insecticide. The second, planted on June 25, was almost completely destroyed by anthracnose and very wet weather, so that from 135 plants only 6 pods were picked. As these plantings were complete failures, they are not included in the table of bean generations.

A third planting of Primera 2d generation was made September 17. Even though the season was much drier than usual, with weather conditions seemingly exceptionally favorable, the plants were badly diseased and did not fully develop their seed, many being obtained in the yield which were not sufficiently developed for either eating or planting. The producing plants gave an average yield of only eight beans per plant, showing a marked falling off in number of both pods per plant and beans per pod.

Primera 3d generation, planted December 24, gave a yield which more than doubled that of the parent generation, but it still amounted to little more than half of the yield of the original planting.

The planting of Primera 4th generation was made March 11, 1911, a year later than the original planting. The yield amounted to less than half that of Primera 1st generation. In the light of further tests it is assumed that this planting fell below the usual production of plantings at this season because the amount of moisture was below the optimum, the rainfall for March, May, and June of 1911 being less than that for these months in any other year during the term of the experiments.

As the original seed had been kept in the drier, some new seed, Segunda 1st, of the same variety, was obtained from the same seed house and planted simultaneously with seed of the original lot, Tercera 1st and Primera 5th, seed from the fourth generation. Fresh seed was procured for comparison with seed kept in the drier, since the seed for Primera 5th generation was quite fresh and could not be strictly compared with the old dried seed without a check on the latter. This planting was made September 16, 1911, and had to contend with very wet weather. There were 37 days with rain, 29.39 inches of which fell between planting and the first picking. The development of many pods and beans was stopped at an early stage by wet weather and disease fostered by such weather.

The differences in average yield per plant of beans of sufficient development to be counted were so slight as to fail to show any degeneration, since the fifth generation yielded 0.4 bean more per plant than one first generation and 0.3 bean less per plant than the other. Since the old seed kept in the drier gave a slightly larger crop than the fresh seed, the intense drying had not injured it. The number of beans per pod in the two first generations was the same. In the fifth generation it was less than in the first two, but this was balanced by the greater number of pods per plant.

The next planting, which was made on December 22, 1911, consisted of a first, a second, and a sixth generation. In contrast with the preceding weather, the rainfall was entirely too small for a good crop, there being but six days with rain and the total precipitation amounting to only 1.68 inches from planting until the first picking of mature beans. As in the preceding case, the advanced generation gave the greater average number of pods per plant. The pod of Primera 6th generation averaged also a slightly greater number of beans than its contemporaries, which is in contrast with the behavior of Primera 5th. The second generation showed the smallest average number of pods per plant and beans per pod. The size of the beans of the second generation was also below that of its contemporaries.

The next planting was made March 12, 1912. It consisted of a first, a second, and a seventh generation. In no other Porto Rican planting did the average yield of beans per plant for any generation whatever equal the average yield of this entire planting. The advanced generation, Primera 7th, led with an average production of 38.5 beans per plant. This was followed by Quinta 1st generation with 35.9, and Cuarta 2d generation with 34.3 beans. Here it is seen that the order corresponds with that of the preceding planting, the advanced generation in the lead, followed by the 1st, and lastly by the 2d generation.

In order to observe any evidence of changes which had been produced in this crop by being grown in the Tropics for from one to several generations, it was decided to make several plantings in the North. For this purpose seed were sent to Minnesota. Through the courtesy of Dr. J. N. Tate, of the Minnesota School for the Deaf, plantings were made June 1, 1912, at Faribault, Minn., of Sexta 1st generation, being seed of the original lot kept over calcium chlorid, of Quinta 2d generation A, and of Primera 8th generation A. The beds were made side by side under very uniform conditions of soil and light. The soil was a friable, rich, black loam, now well drained but having formerly been swamp land. All received the same treatment, all blossomed about the same time, and all were picked on the same date. All made a strong, vigorous growth and were much taller and more luxuriant than any plantings in Porto Rico. Though all were thrifty and vigorous, those whose antecedents had been grown for seven generations in the Tropics showed a little less pronounced vigor than the other two, between which no distinction could be made.

The average number of beans per pod was identical for all—that is, 3.41. In number of pods per plant the 1st generation, plants whose forbears had never been grown in the Tropics to our knowledge led, followed by the 8th generation, and lastly the 2d generation. In yield of beans, the average crop per plant ran 50, 43.6, and 41.2 beans, respectively, yields never equaled in any of the Porto Rican plantings.

Though a counting of the number of beans of the original lot which would be contained in one-half liter was never made, new seed received from the North January, 1913, ran 1,103 beans. Those grown in Minnesota ranged from 1,009 to 1,111. It may be assumed from these four counts of northern-grown seed of this variety that the original lot of northern-grown seed ran somewhat the same. The seed harvested from Primera 7th generation ran 1,226, and from Quinta 1st, 1,268, beans to the half liter. These Porto Rican grown seed, then, were considerably smaller than the northern-grown seed, and this in itself might account for the larger crop from Sexta 1st.[1]

The next planting in Porto Rico was made January 17, 1913. It consisted of four 1st generations in that the parent generation of each had been grown in the North. Octava 1st was from new seed just received from the North; the other three were from the Minnesota crops of the previous summer, Minn. A 1st from Sexta 1st, Minn. B 1st from Quinta 2d A, and Minn. C 1st from Primera 8th A. Minn. A 1st produced an average of 17 beans per plant, while the others ranged from 13.1 to 13.6 beans. It is thought that perhaps Minn. A 1st was in a slightly moister location than its contemporaries, as no other explanation for this difference can be seen.

The next planting was made November 8, 1913. As a whole, it gave a lower average than any other lot of plantings. It consisted of two 1st generations, five 2d generations, and one 8th generation. The average yield of the two 1st generations was 5 beans, of the five 2d generations, 4.1 beans, and of the 8th generation, 4.7 beans per plant. The 2d generation average yields ranged from 3.3 to 5.8 beans per plant, including thus the smallest and the largest average yield. Such yields show the very marked seasonal effect, but little else. It is interesting here to compare the yields of two plantings made from the same lot of seed, Quinta 2d A, planted in Minnesota and yielding an average of 41.2 beans per plant, and Quinta 2d B, planted in Porto Rico and yielding 5.8 beans per plant.

The final planting was made March 26, 1914. It consisted of two 1st generations, two 2d generations, five 3d generations, and one 9th generation. The number of plants in all rows was somewhat reduced by a Sclerotium blight. Except for this, conditions were

[1] See Vermont Sta. Bul. 177 (1914).

very favorable. The two 1st generations gave the largest crops, averaging 33 and 35.4 beans per plant. This may be accounted for, as mentioned before, by a difference in the size of the seed, since in no instance whatever did any Porto Rican grown seed equal in size those from the North, as indicated by the number of beans counted in one-half liter. The 2d generations averaged 26.6 beans per plant, the 3d generations 27.4 beans, and the 9th generation 29.3 beans. Though the 9th generation averaged more than the average of all the 3d generations, one of the latter equaled it and another exceeded it in yield.

In nearly all plantings some plants produced either no pods or pods with beans of too small a size to be considered. These nonproductive plants varied considerably in number, but in no very uniform or consistent manner. They are not included in the table or the preceding discussion, but deserve mention. In the September, 1911, planting of the two 1st generations, one produced 19 such plants and the other only 6, while the 5th generation included only

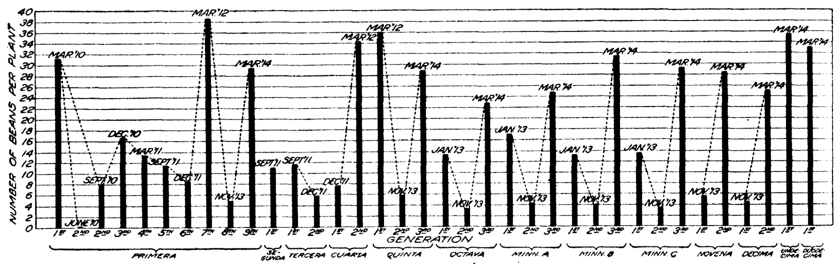

FIG. 2.—Average yields of bean generations, the number of beans per plant being indicated by heavy lines, with lineal generations connected by dotted lines. The appended dates are those of planting.

4. In the next planting of a 1st, a 2d, and a 6th generation, 5 nonproductive plants were included in each. In the November, 1913, planting these plants ranged from 2 to 5 in the 1st generations, and from 2 to 26 in the 2d generation, with 20 in the 8th generation. Though these tests did not afford sufficient data for a systematic classification of this tendency, more of such plants were observed in the fall plantings than in plantings made at other seasons.

Two diagrams are appended in order that the results of these plantings may be clearly shown. In figure 2, the yields of the lineal generations are shown, and it is seen that the only uniformity indicated is a large yield at certain seasons and a poor yield at others. No indications of degeneration are seen. In the other diagram, figure 3, the points determining the curve of the 1st generation were obtained by taking an average of all 1st-generation plantings made in any one month. These points were then connected by lines, thus forming a curve showing the yields of 1st-generation plantings at different seasons. The yields of the 2d and 3d generations are shown in the same way. Of each of the more advanced generations only a single planting was made. These are indicated by crosses. This indicates very clearly the main factor governing the yield.

In considering the many plantings that have been made, it is seen that the matter of a large yield or a small yield of this particular crop is not influenced by the progenitors having been previously grown in the Tropics for a long time or a short time or not at all, but is chiefly a matter of the planting being made at the proper season. At certain

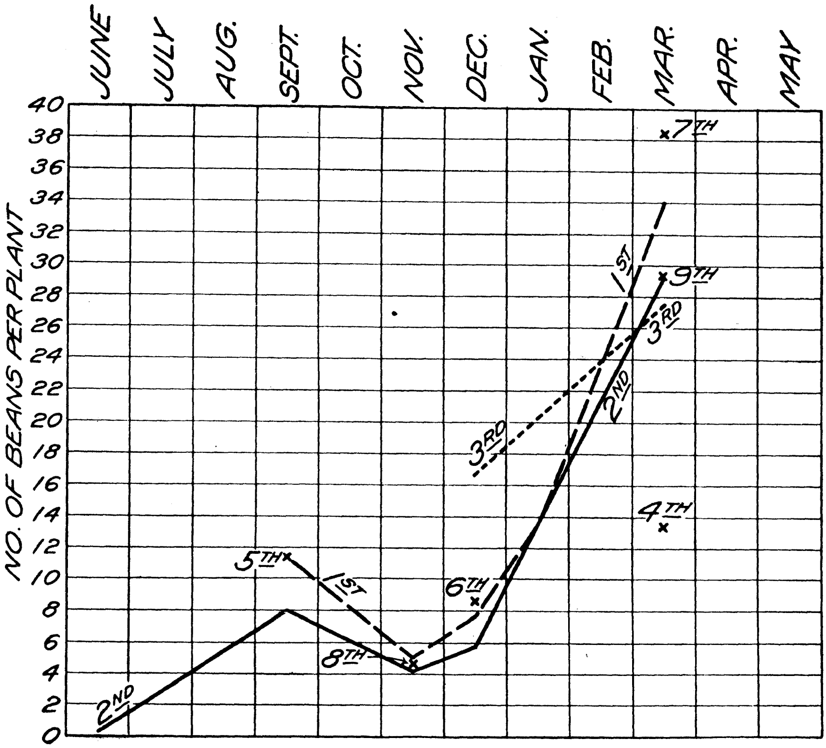

FIG. 3.—Yields of different bean generations as affected by planting season.

seasons all plantings gave a poor yield, at other seasons all produced excellent crops.

OKRA.

In the work with okra the White Velvet variety only was planted. The seed used here was grown in Georgia and was sent to Porto Rico by J. M. Thorburn & Co., of New York City. The plantings of okra were made in the field in beds which were all 25 feet long, except those for the 1911 plantings, which were 32 feet long. These beds were prepared in the same manner as for other crops. The seed was always planted thickly, and the seedlings were later thinned to 1 foot apart. In order to secure records of yields of mature pods and of the number of seeds per pod, and to obtain seed for future generations, the pods of one-third of the plants were left to mature. The pods of the remaining plants were harvested when in marketable condition.

Table II gives the results of the 32 plantings of okra and needs but little explanation. Great differences in growth and yield were noted between plantings made at different seasons, but when grown side by side the development of the more advanced and the early generations was so uniform that no consistent differences could be seen. During the first year of the experiment, three generations were grown, one generation only being grown at a time. The results of these plantings show a decided falling off in both yield and plant growth of the second and third generations. The second generation, planted July 16, gave by far the lowest yield, but this was due to the unfavorable season, since the yield is invariably small when okra is planted in summer or fall in the western part of the island.

TABLE II.—*Okra generations.*

Date of planting.	Name.	Number of days covered.	Average number of marketable pods per plant.	Average number of mature pods per plant.	Average length of mature pods.	Average number of seed per pod.	Average height of plants from which pods were cut green.	Average height of plants which matured seed.	Average growth of plants from which pods were cut green.	Average growth of plants which matured seed.
					Inches.		*Inches.*	*Inches.*	*Inches.*	*Inches.*
Mar. 12, 1910	Primera 1st	203	140.8	29.3	......	74.6	93.1	59.5	......	......
July 16, 1910	Primera 2d	206	50.1	6.6	......	62.2	61.3	36.6	......	......
Dec. 12, 1910	Primera 3d A	222	120.0	15.3	......	36.5	38.8	15.8	......	......
Mar. 11, 1911	Tercera 1st	[1] 240	97.4	18.0	......	68.5	78.4	47.1	......	......
Do	Primera 3d B	[1] 240	77.8	10.3	......	68.3	73.4	37.4	......	......
June 10, 1911	Cuarta 1st	171	45.1	8.0	......	63.9	72.0	45.8	......	......
Do	Primera 4th	171	44.4	8.4	......	67.2	67.6	46.3	......	......
Jan. 22, 1912	Quinta 1st	235	126.2	12.2	......	56.1	72.2	18.6	......	......
Do	Cuarta 2d A	235	162.0	15.8	......	60.7	100.7	......	......	......
Do	Primera 5th A	235	114.6	11.3	......	59.3	55.7	14.1	......	......
Mar. 12, 1912	Tercera 2d	200	86.4	29.9	......	73.8	86.6	56.6	......	......
Do	Primera 5th B	200	82.0	17.1	......	67.9	67.5	38.8	......	......
May 13, 1912	Cuarta 2d B	138	31.1	7.8	......	74.9	76.4	58.3	......	......
Do	Primera 5th C	138	28.3	5.0	......	64.7	62.8	50.4	......	......
Jan. 4, 1913	Sexta 1st	241	155.7	14.4	6.16	54.7	74.1	26.4	......	......
Do	Quinta 2d	241	122.6	18.3	5.99	52.1	64.3	25.5	......	......
Do	Tercera 3d	241	127.8	23.6	6.04	51.4	71.6	31.4	......	......
Do	Cuarta 3d	241	112.0	19.4	6.29	60.9	56.6	24.4	......	......
Do	Primera 6th A	241	124.8	14.1	6.04	53.0	62.6	25.4	......	......
Nov. 8, 1913	Septima 1st	146	41.7	13.5	......	50.5	39.5	29.0	95.4	47.8
Do	Sexta 2d	146	49.9	12.3	......	55.8	50.6	31.9	127.1	50.0
Do	Quinta 3d	146	43.6	9.4	......	48.5	35.3	16.6	91.1	27.1
Do	Tercera 4th	146	67.2	13.4	......	61.1	54.7	26.3	147.8	44.0
Do	Primera 6th B	146	58.3	17.2	......	48.7	40.9	25.4	144.3	59.4
Do	Primera 7th A	146	54.9	10.9	......	54.7	36.8	23.6	92.0	34.8
Mar. 26, 1914	Octava 1st	187	74.0	17.3	......	71.0	93.1	49.0	303.6	139.7
Do	Septima 2d	187	51.7	17.6	......	69.9	81.8	54.6	237.8	140.8
Do	Sexta 3d	187	62.9	12.1	......	64.6	86.6	68.6	236.9	167.3
Do	Quinta 4th	187	68.5	10.4	......	67.8	79.5	58.7	220.4	146.3
Do	Tercera 5th	187	71.8	17.9	......	68.7	87.1	58.3	346.5	145.6
Do	Primera 7th B	187	60.6	11.7	......	64.0	76.2	45.0	202.5	100.8
Do	Primera 8th	187	67.6	13.6	......	70.7	77.8	53.0	260.7	145.3

[1] Plants which matured seed were left only 166 days.

In the plantings made during the following years, two or more generations were planted side by side on the same date, so that there would be no differences in development of the different generations due to weather conditions. In 1911, two crops were grown, a 1st and a 3d generation planted in March, and a 1st and a 4th generation planted in June. The plantings made on the latter date produced a very uniform growth and gave a yield which was almost identical for the two generations, but the earlier crop shows a greater plant growth and a heavier yield from the imported seed. In two of the three later crops in which the 1st and the 3d generations were grown simultaneously, the yield of green pods of the 1st generation was higher than that of the 3d, and in two cases the same was true of the yield of mature pods, while in one case the third generation bore more than the first. In the plantings of January, 1912, March, 1912, and May, 1912, the growth of the plants and the yields were higher for the 2d than for the 5th generations, but these results were not in accord with other plantings. A notable result will be seen in the yield of three plantings of Primera 5th generation made in 1912. The first of these three plantings was made on January 22, the second on March 12, and the third on May 13. The yield of marketable pods per plant was 114.6, 82, and 28.3 respectively. These results show the marked effect of climatic conditions and the importance of testing degeneration by comparison of plantings made simultaneously. In the last three crops of the experiment, one planted in January, one in November, and one in March, five, six, and seven plantings respectively were made simultaneously. These plats gave excellent opportunity to observe the effect of climatic conditions on okra when grown in Porto Rico for a long or short period. Aside from the relative production of green pods, only minor differences were found in any of the details under observation for the different generations planted at the same time. The production of green pods in the row planted to the imported seed was markedly heavier than that of later generations in two of the three trials, and lower in the other. The growth and general appearance of the plants of the different generations were very uniform.

Where a number of generations were planted simultaneously, the central rows of the plat were planted to imported seed, to seed of the 2d, and to the most advanced generations. Where a number of rows were planted, the possible variation existing in soil condition between different sections of the plat was probably responsible for the small differences in yield of the various generations, as the differences are not consistent and follow no line of advance or decline. The results obtained in the five years' work with okra, during which 32 plantings were made at 11 different dates, reaching finally the 8th generation, indicate that with this crop there has been no degeneration resulting from the climatic or soil conditions in Porto Rico, and that the home-grown seed from advanced generations is as valuable for planting as the northern-grown seed.

The growth and productiveness of no other vegetable crop in Porto Rico is influenced by climatic conditions more than okra. Summer and fall plantings result invariably, at least on the western part of the island, in an exceedingly poor plant growth and low fruit production, while winter plantings always give large and prolific plants.

In figure 4, the yield per plant for each okra planting is shown graphically, together with the effect of the season on the harvest, the curves being formed by connecting the yield of plantings made in different months without indicating the parentage of the seed planted. The regular curve in the line showing the production of marketable pods is especially interesting, as it shows marked seasonal effect on production, emphasizes the importance of planting from December to March if large harvests are desired, and indicates the small crop

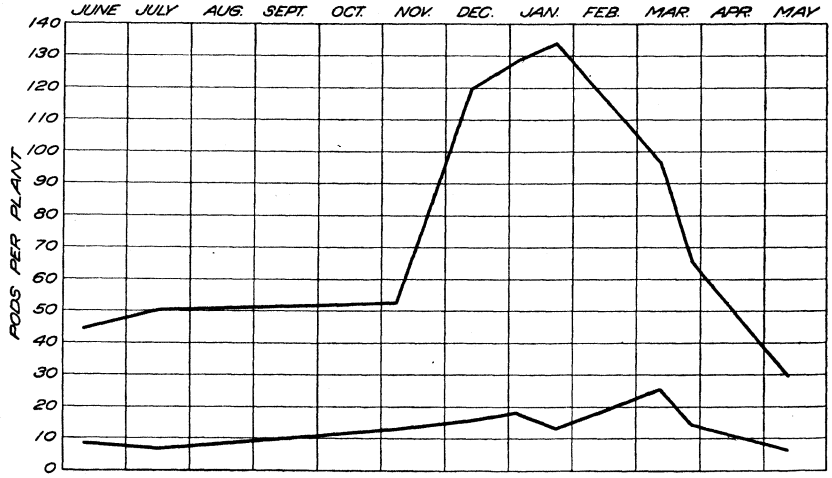

FIG. 4.—Okra yield as affected by planting season. The upper curve represents the yield of plants from which the pods were cut when in marketable condition; the lower curve, of plants on which the pods were allowed to mature.

likely to result from plantings made during the period from May to November.

In figure 5 is shown the production from seven plantings of imported seed and from lineal descendants of all except the last. The dates of planting are given at the points showing the average yield of marketable pods per plant harvested from that planting, and this point is connected by a dotted line with the point which shows the average production per plant of the next generation.

TOMATOES.

In the work with tomatoes two varieties were used, Royal Red and Honor Bright. These will be discussed separately.

Royal Red.—The seed of Royal Red tomatoes was from the Congressional seed distribution of 1909 and had been grown in the State of California. That for the later plantings was preserved over calcium chlorid, so that only seed derived from this one lot was used. The seed was planted in flats or pots, and 11 to 13 days later, the seedlings were transplanted to small individual pots. From 24 to 29 days after sowing 13 plants were set in the field 2 feet apart in the row. In several instances this number was reduced through insects or disease. The plants were staked, but usually left unpruned. In recording yields, tomatoes weighing 25 grams or less were not

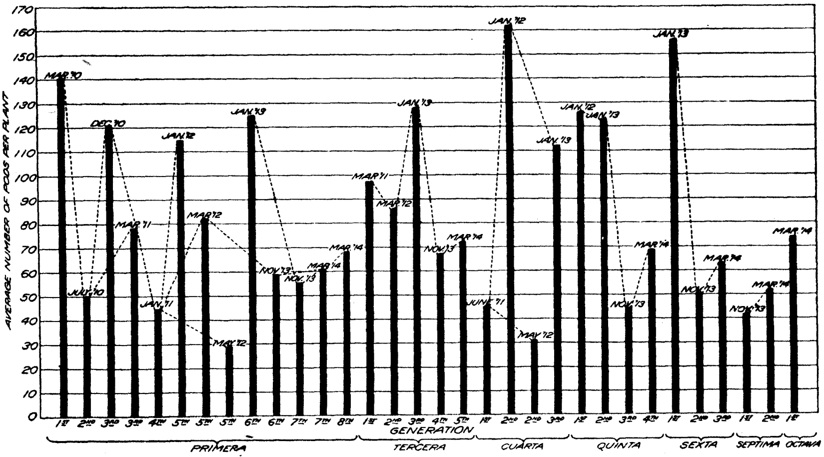

FIG. 5.—Average yields of okra generations, the number of pods per plant (cut when in marketable condition) being indicated by heavy lines and the lineal generations connected by dotted lines. The dates are those of planting.

counted. Table III shows the results of the plantings of this variety of tomatoes.

Table III.—*Tomato Royal Red generations.*

Date of planting.	Name.	Number of days from planting to blossoming.	Number of days from blossoming to fruit picking.	Number of days covered.	Number of plants.	Average number of fruits per plant.	Average weight of 1 fruit.
							Grams.
Mar. 12, 1910	Primera 1st	55	39	196	11	13.6	112.5
Sept. 17, 1910	Primera 2d	65	57	(1)			
Mar. 11, 1911	Primera 3d	62	39	206	12	8.6	94.5
Oct. 16, 1911	Primera 4th	63	49	220	11	19.3	86.5
Mar. 12, 1912	Primera 5th A	60	45	161	6	8.0	86.1
Do	Segunda 1st	60	52	161	6	5.0	88.3
Sept. 14, 1912	Tercera 1st	72	50	191	4	21.8	85.3
Do	Segunda 2d	78	44	191	5	23.8	68.8
Do	Primera 5th B	64	54	191	4	23.5	80.8
Do	Primera 6th A	69	41	191	5	24.8	73.2
Feb. 24, 1913	Cuarta 1st	68	44	136	13	2.2	68.7
Do	Tercera 2d	66	36	136	13	3.8	71.3
Do	Segunda 3d	66	35	136	13	2.3	67.5
Do	Primera 6th B	64	41	136	13	4.7	81.6
Do	Primera 7th A	68	33	136	13	3.5	61.7
Oct. 27, 1913	Quinta 1st	57	48	180	12	29.2	93.8
Do	Cuarta 2d	63	42	180	13	32.1	102.0
Do	Tercera 3d	61	44	180	13	30.2	94.8
Do	Segunda 4th	62	43	180	12	32.3	88.2
Do	Primera 6th C	68	45	180	13	17.6	100.6
Do	Primera 7th B	62	46	180	13	27.0	95.6

[1] Vines thrown down by rainstorm when crop was only partially collected.

The first planting was made March 12, 1910. The climatic conditions were favorable for a rank growth of vine, but unfavorable for fruiting. Toward the end of June, as almost no blossoms were setting fruit and as the plants had developed into a great mass of leaves and branches, about a third of the growth was pruned away. The average yield of tomatoes per vine was not high, but the tomatoes were larger in size than those from any other planting, even though four other plantings were made from the same lot of seed used for this one.

Primera 2d generation was planted September 17, 1910. When this crop was only partially collected a heavy rainstorm threw down the plants, breaking them badly and knocking off so many immature fruits that any record of yield was made valueless. In quality this generation was far ahead of the 1st generation, the fruits being much smoother and firmer with a smaller percentage showing broken skin or creases at the stem end. This difference in quality was evidently a seasonal effect.

Primera 3d generation was planted March 11, 1911, a year later than the first planting. Not only were the fruits considerably smaller than those of the first generation, but the average yield per plant was less than two-thirds that of the first planting. Here again the broken skin at the deeply creased stem ends was very noticeable, many fruits spoiling soon after they were sufficiently ripe for eating.

Primera 4th generation was planted October 16, 1911. Both in total weight and number of fruits per plant this exceeded the 1st and 3d generations, but the average fruit was smaller than that of the 3d generation, which, in turn, was smaller than that of the 1st, thus presenting a steady decline in size. Since the locally grown tomato is quite small, this would suggest that local conditions perhaps favor the production of tomatoes yielding small fruits.

This theory, however, was not borne out by the next plantings, which were made March 12, 1912. The difference in size between Primera 5th A and Segunda 1st generation was so small as to be negligible. The average fruit of Primera 5th generation A measured 2.24 inches by 2.07 inches in horizontal diameters, and 1.66 inches in vertical diameter, while the average fruit of Segunda 1st generation measured 2.31 inches by 2.08 inches in horizontal diameters and 1.73 inches in vertical diameter. The difference in number of seed was also well within the allowance for experimental error, the number averaging in the former case 106.2 seeds, and in the latter 116.8 seeds per fruit. The advanced generation here produced a greater number of fruits than the 1st generation.

Four generations were planted September 14, 1912, a 1st, a 2d, a 5th, and a 6th. Owing to very wet weather and to mole crickets, the number of plants was reduced considerably more than was desirable for the tests. The production of fruits was very uniform, averaging from 21.8 to 24.8 fruits per plant. The total yield per plant for the 1st generation weighed a little less than that of the 5th generation and a little more than that of the 6th.

Five generations were planted February 24, 1913. The best planting made on this date produced fewer fruits than the poorest made at any other time. The average number of fruits produced ranged from 2.2 to 4.7 per plant. Beginning with the one giving the largest yield, the generations were in descending order 6th, 2d, 7th, 3d, and 1st.

The last planting was made October 27, 1913. With the exception of a 5th generation, all generations from 1st to 7th were represented. From some evidently very local but unknown cause the plants in one end of the row of Primera 6th C were dwarfed and greatly retarded in

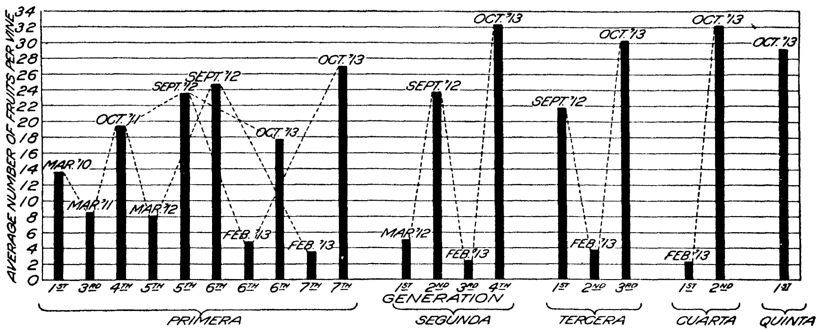

FIG. 6.—Average yields of Royal Red tomato generations, the number of fruits being indicated by heavy lines and the lineal generations connected by dotted lines.

their development materially decreasing the yield of this row. The other rows gave an average yield of 27 to 32.3 tomatoes per plant, the 4th and 2d generations leading in number of fruits produced. In size, the tomatoes of the 2d generation were the largest and those of the 4th generation were the smallest. Excepting Primera 6th C, the yield of the poorest row planted at this date exceeded the best yield of any other planting.

In figure 6, the number of fruits produced by each planting is diagrammatically shown in connection with the number produced by its lineal forbears and its descendants. The planting dates are appended in each case. This diagram is so similar in form to that showing the total yield by weight of fruit produced by the average plant that the latter diagram is not included.

These diagrams clearly show that there is no uniformity of behavior where the number of ancestral generations grown in the Tropics is considered as the main factor. This is particularly noticeable in the

Primera group, of which more plantings were made than of any other. The one striking feature is the grouping of the late winter and spring dates on the one hand and the autumn planting dates on the other, showing the planting date to have been the real factor in determining the yield. In figure 7 this is clearly demonstrated where all plantings made on the same date are connected by lines. The small yield of the 6th generation in the October, 1913, planting, which is the only thing to mar the symmetry of this chart, has already been explained.

The tomatoes planted in the fall on the whole had a slightly larger average size than those planted in the late winter and spring, but this was not uniformly the case. However, the main factor seemed

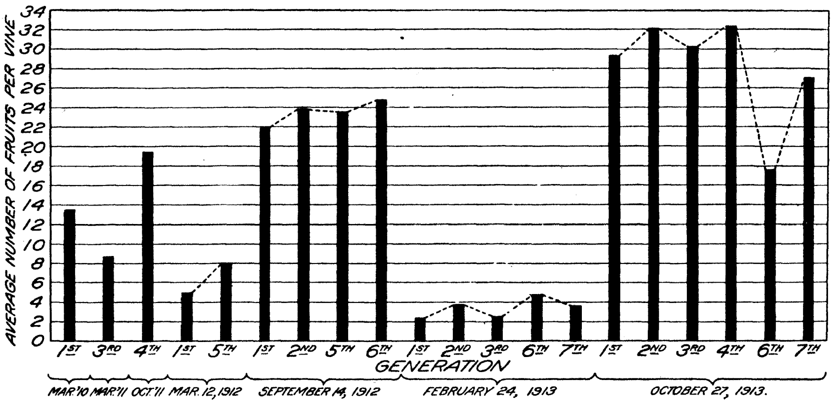

FIG. 7.—Average yields of Royal Red tomato generations, the number of fruits being indicated by heavy lines and simultaneous plantings connected by dotted lines.

to be the time of planting. The number of ancestral generations which had been grown in the Tropics failed to show any effect on size.

An analysis of the whole subject shows that, though tomatoes from northern seed were grown for seven generations in the Tropics, this change of habitat apparently had no effect on either size or number of fruits produced. The one factor influencing production which rose far above all others was the season at which the planting was made.

Honor Bright.—The seed of Honor Bright tomatoes was from the 1910 crop grown in California for J. M. Thorburn & Co., of New York City. In tests of this variety, eight plants were set 4 feet apart in the row. The general treatment followed was the same as that for the Royal Red variety, except that less manure was used in the preparation of the beds. The results of the plantings are given in Table IV.

TABLE IV.—*Tomato Honor Bright generations.*

Date of planting.	Name.	Number of days from planting to blossoming.	Number of days from blossoming to fruit picking.	Number of days covered.	Number of plants.	Average number of fruits per plant.	Average weight of fruit.	Horizontal diameters of average fruit.	Vertical diameter of average fruit.
							Grams.	*Inches.*	*Inches.*
Dec. 10, 1910	Primera 1st	57	48	208	6	51.2	104.6	2.57 by 2.37	1.77
May 24, 1911	Primera 2d A	82	196	278	8	.3	13.0	....	......
Mar. 12, 1912	Primera 2d B	60	45	161	8	3.1	78.9	2.20 by 2.01	1.53
Dec. 10, 1912	Primera 3d	60	42	210	7	90.7	104.9	2.43 by 2.40	1.80

The first planting was made December 10, 1910. The fruits were large to medium in size, and the average production per plant was 51.2 fruits.

The first planting of the 2d generation was made May 24, 1911. By the middle of August the plants began to blossom. In early October it was noted that blossoms were seen only very rarely and that these did not set fruit. By this time one plant had died, and two more were nearly dead. Near the end of February of the following year, two tomatoes, one weighing 18 grams and the other 8 grams, were produced on plants which were then entirely leafless, only one plant still having green leaves. This demonstrated very forcibly the uselessness of attempting to produce tomatoes in the season of heavy rains.

A second planting of the 2d generation was made March 12, 1912. The fruits produced were small in size and few in number. They, however, furnished sufficient seed for a planting of the 3d generation.

The 3d generation, which was planted December 10, 1912, far excelled any other planting. The average size of the tomatoes was about the same as that of those of the 1st generation, but the number produced was 90.7 fruits per vine. The total weight of fruit per vine was about 21 pounds.

The yields showed the seasonal effects in even more pronounced contrast than did the plantings of Royal Red tomato, though fewer plantings were made. The data serve to substantiate the conclusions reached in the tests of the other variety.

LETTUCE.

The lettuce plantings were from seed of Prize Head lettuce, grown in California and received in the Congressional seed distribution of 1909. The young plants were transplanted to individual pots 10 to 13 days after sowing. When sufficiently large, two or three weeks later, 25 to 30 plants were set in the field, 1 foot apart in the row.

Where a plant was injured so as seriously to retard its development, or varied decidedly from the others, it was removed. Alternate plants were left for seed, and the others were cut to supply the desired data. In the plantings of January, 1914, no plants were reserved for seed. The beds were cut at the first indication of a blossoming stalk starting up. Where one or several dried leaves were found, these were discarded and the head then weighed. The remaining leaves were then counted, including all an inch or more in length. Excepting the plantings on the last two dates, measurements were taken of the length and breadth of the 12 outer leaves on six average heads of each planting, the length being measured along the midrib, and the breadth at the widest portion of the leaf. The results are given in Table V

TABLE V.—*Lettuce generations.*

Date of planting.	Name.	Number of days from planting to cutting.	Average weight of head.	Average number of good leaves.	Average length of leaf.	Average breadth of leaf.
			Grams.		*Inches.*	*Inches.*
Mar. 12, 1910	Primera 1st	63	169.2	24.7	6.84	6.55
Jan. 2, 1911	Primera 3d	75	97.9	19.5	5.59	6.40
July 6, 1911	Primera 4th	76	54.2	18.7	4.66	4.86
Dec. 13, 1911	Primera 5th A	72	124.4	27.3	5.84	6.45
Mar. 12, 1912	Segunda 1st	66	195.0	29.3	6.04	6.82
	Primera 5th B	66	223.1	30.8	6.05	6.95
Nov. 7, 1912	Tercera 1st	72	63.3	18.0		
Mar. 27, 1913	Cuarta 1st	75	199.4	28.9		
	Tercera 2d A	75	136.1	24.6		
Jan. 17, 1914	Quinta 1st	74	127.8	25.1		
	Tercera 2d B	74	109.2	24.2		

The first planting, which was made March 12, 1910, gave a satisfactory yield.

Seed from this generation were planted repeatedly, but sufficient plants for a test were never obtained. This same condition of poor seed with a low percentage of viability was found to be quite common where plants blossomed and seed was produced in rainy weather.

Four 2d generation plants were finally obtained, but only one of these lived to blossom. From this plant seed ripened in December and was used for Primera 3d generation, which was planted January 2, 1911. Though this generation was left uncut 12 days longer than the 1st generation, the plants produced fewer and smaller leaves and weighed considerably less. Ripe seed was collected from these plants in May and June.

Primera 4th generation was planted July 6, 1911. In number and size of leaves and weight of head it fell far below the 3d generation.

Primera 5th A, which was planted December 13, 1911, produced a much better growth than either of its two nearest ancestral generations, but in weight it did not equal the 1st generation.

Two years after the original planting a simultaneous planting was made of a 1st generation and a 5th generation. Owing to very wet weather, very few and poor seed were obtained from the 4th generation, and the young seedlings from this generation were much slower in germinating and, as young plants, were vastly inferior in size to the plants of the contemporaneous 1st generation. However, before maturity the average size of plants of the 5th generation was considerably larger than that of the 1st generation plants, not only showing no degeneration, but excelling in size the 1st generation plants, even though handicapped by a poor start.

The leaf measurements of these two simultaneous plantings showed no change to have taken place in the general shape of the leaves.

The 5th generation showed a tendency toward earlier blossoming than the 1st generation.

On account of rainy weather no seed was obtained from these plantings.

Seed from 5th generation A and seed of the original lot were sent to Washington and planted at Arlington Experimental Farm through the kindness of the horticulturist, D. N. Shoemaker. He reported in letter of December 31, 1912, as follows:

> * * * On July 3 it was noted that the 6th generation lettuce in comparison with the other two was decidedly less frilled and not quite so deep in color. On July 13 it was noted that the 6th generation showed smoother edges and lighter color, but was larger and more vigorous in plant than the 1st generation or the American seed. On July 30 it was noted again that the lettuce of the 6th generation was certainly not so deep in color and was less frilled to the edge of the leaf than the 1st generation. Also it was quite notable that it was tenderer than either of the other numbers planted for comparison.
>
> On September 4 we noted on some plants which had been lifted and planted in a frame that the plants of the 6th generation grown in Porto Rico were larger and more vigorous than the others but were rather inferior in varietal character.
>
> Would say in summing up the observations that the difference between the lettuce of the 6th generation and first generation from Porto Rico seems very likely to be that which would result from a selection of the varieties in any region without a strict adherence to the varietal type; that is, that the difference observed here would very readily occur in the same number of generations on any American farm if the seed-bearing plants each year were not strictly compared with an ideal varietal type.

Several other plantings were made in Porto Rico after this date.

On November 7, 1912, another planting of 1st generation was made. The heads were next to the smallest of any produced. Measurements of the average length and breadth of the 12 outer leaves on six average heads showed that in the 1st generation the length and breadth of leaf were not in uniform relation, since on three heads the sum of the leaf lengths exceeded the sum of the breadths in each case, while the reverse was true with the three others. This lack of uniformity was also found in Primera 1st but did not appear in Primera 5th B or Segunda 1st. Its appearance in two 1st generation plantings showed it too unstable a factor to be regarded, so further leaf measurements were not taken.

Two more plantings of 1st generations were made simultaneously with 2d generations, and in each instance the 1st generation gave the better yield.

In only the earlier of these two plantings were plants left for seed. In this instance the 2d generation showed a tendency toward earlier blossoming than the 1st.

In reviewing the various lettuce plantings, no degeneration caused by being grown for a number of generations in the Tropics is evident. On the contrary, indications point toward an improvement in the advanced generation.

The production of well-formed and viable lettuce seed in some seasons here is practically impossible, and for this reason it will usually be found best to import seed for this crop. The difference in yield of 1st and 2d generations, when planted simultaneously, may or may not have been due in part to a difference in vigor caused by a difference in size of seed.

As with the other crops previously discussed, the prime factor nfluencing production seemed to be the planting season.

PRESERVING THE VIABILITY OF VEGETABLE SEED.

The humidity of the air in Porto Rico is very high and causes vegetable seed exposed to the open air to lose their viability much sooner than would be the case in a drier atmosphere. The inability to keep seed in good condition is a serious hindrance to vegetable growing. When the experiments herein reported were undertaken, the following method for preserving seed was employed and was very satisfactory. The seed in cotton sacks was placed in air-tight glass jars in the bottom of which a few ounces of calcium chlorid had been placed. A small piece of wire screening separated the seed from the calcium chlorid below. (See fig. 8.) This method is simple and costs little, and is recommended for general use. While glass jars were used in experiments, metal or nonporous earthen vessels will serve as well if made air-tight. It must be remembered that the calcium chlorid placed in the bottom of the jar is used as a drying agent and not as a preservative in any other sense. Seed such as coffee and citrus, which lose their viability on drying, can not be kept viable in this way. If seed with a fairly high water content is to be stored, it may be necessary to renew the calcium chlorid, since, unless a sufficient quantity of calcium chlorid is used to take up the surplus water, the seed may not be kept sufficiently dry. Before the calcium chlorid becomes entirely moist, it should be replaced by a fresh supply. In handling it should be exposed as short a time as possible to the open air, since it takes up moisture from the air readily and so loses its drying power. In removing seed from the container this should be remembered.

Germination tests were made of seed of a number of different vegetables, a Geneva seed tester being used. To bring out more clearly the results of these tests, they have been plotted as curves. The native tomato seed of which tests are recorded in figure 9 was collected in the winter of 1910. The other seed was imported, coming

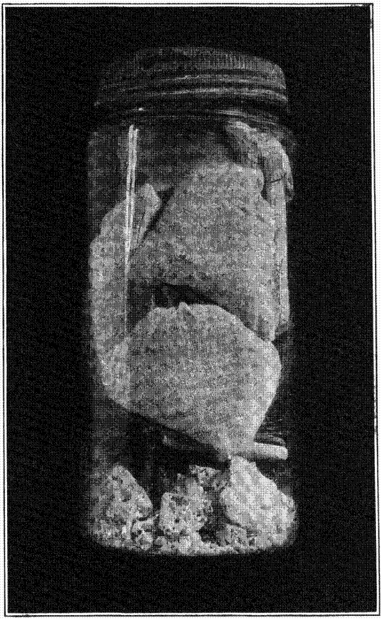

FIG. 8.—Air-tight jar illustrating method of preserving seed over calcium chlorid.

presumably from the 1909 crop. A portion of each was kept in the drier and another portion was exposed to the open air.

In the last germination test of bean seed which had been kept in the open the seed was put in the tester October 29, 1910, germinating 4 per cent. On this date, 100 per cent of the seed kept in the drier germinated. This seed from the drier still showed a 100 per cent germination nearly two years later, August 13, 1912, when the tests had to be discontinued on account of a scarcity of seed.

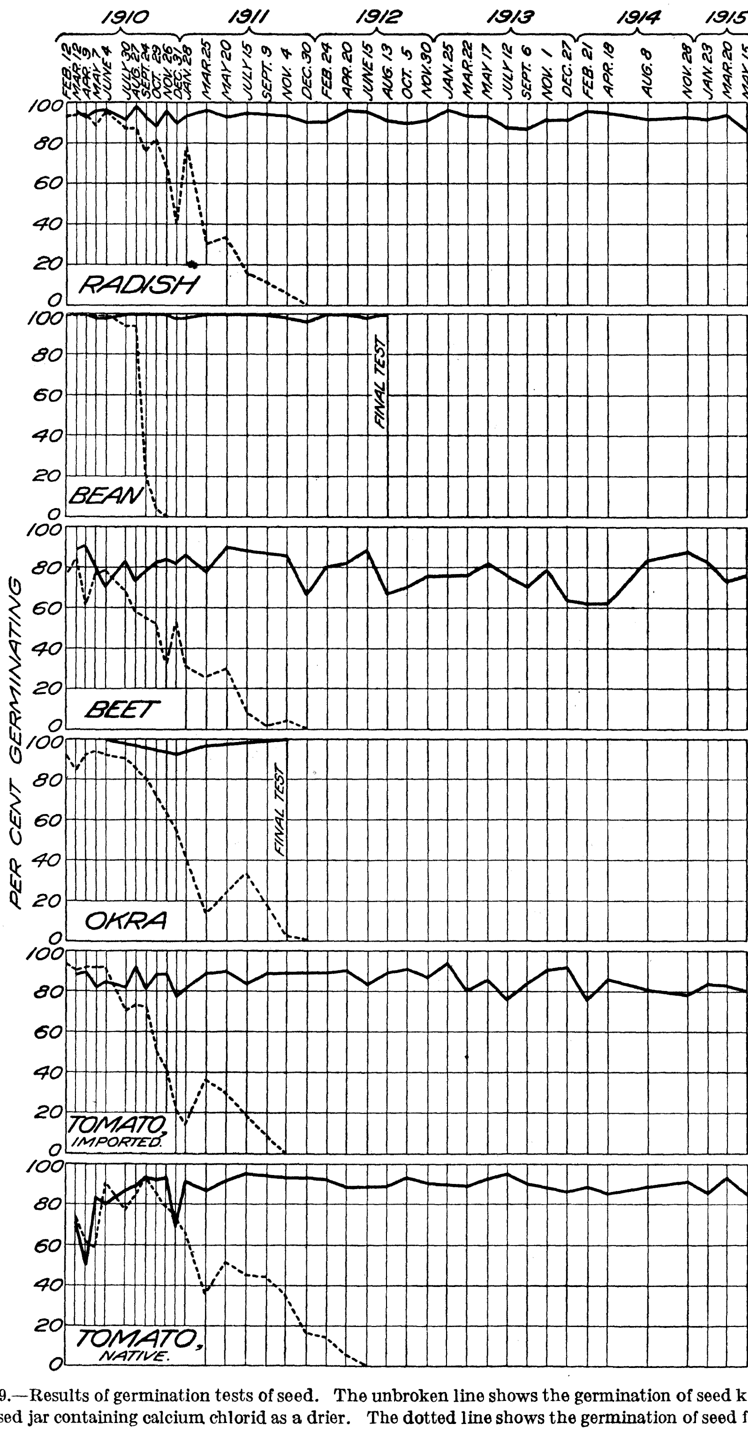

FIG. 9.—Results of germination tests of seed. The unbroken line shows the germination of seed kept in a closed jar containing calcium chlorid as a drier. The dotted line shows the germination of seed from the same lot kept in cotton sacks exposed to the air.

By the end of 1911 all of the imported seed kept in the open air had lost its viability. In 1915, 94 per cent of the radish seed and 84 per cent of the beet and tomato seed kept in the drier still germinated.

Unfortunately, the supply of okra seed in the drier was too small to allow a long continuance of tests. On November 4, 1911, 100 per cent of the seed from the drier germinated, while of that in the open only 2 per cent germinated. It was found necessary before planting to file okra seed which had been kept in the drier.

The native tomato seed, after more than five years in the drier, showed a germination of 93 per cent, whereas seed kept in the open lost all viability in less than half that time.

In figure 10 the loss of viability of imported seed of a number of different vegetables is graphically shown. The very rapid loss of

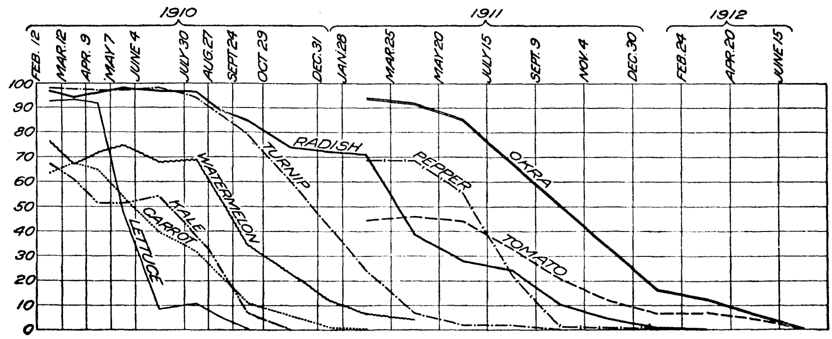

Fig. 10.—Loss of viability of imported vegetable seed exposed to the open air. The tests begun Feb. 12, 1910, were of seed presumably collected the preceding season; those begun Jan. 28, 1911, presumably were from the 1910 crop. The dates of the germination tests are given above. To eliminate as far as possible errors of individual tests, the curves were plotted by connecting points midway between the germination percentages so as to occupy a mean position in respect to them. Tests not made were of kale Aug. 27, 1910; turnips, Dec. 31, 1910; okra, Sept. 9 and Nov. 4, 1911.

viability of lettuce seed kept in the open air stands in marked contrast with the results of tests of seed of the same lot which had been kept in the drier and which showed a germination of 90 per cent in 1915.

In figure 11 the loss of viability of home-grown seed is shown.

SUMMARY.

That northern vegetables degenerate quickly when taken to the Tropics is a common belief in Porto Rico, resulting from the fact that seed loses its viability quickly when exposed to moist air and from a lack of knowledge regarding seasonal effect on vegetable production.

To retain the viability of seed of the crops used in the experiments here reported, the seed was stored in air-tight jars in the bottom of which was placed a small quantity of calcium chlorid. This method was so satisfactory that it is recommended for general use.

Planting a few types of peppers, such as are commonly grown in Porto Rico, side by side with varieties imported from the North showed that the Porto Rican types are much more productive and therefore more desirable than imported varieties.

Forty plantings of beans were made, including nine generations. Of the Porto Rico plantings, those made in March gave large crops, except one in 1911, which was hindered by an exceptional drought, while those made in other months, including June, September, November, December, and January, gave small harvests. No indications that advanced generations were inferior to earlier ones were observed.

Records of the five years' work with okra, during which time 32 plantings were made, reaching finally the eighth generation, show

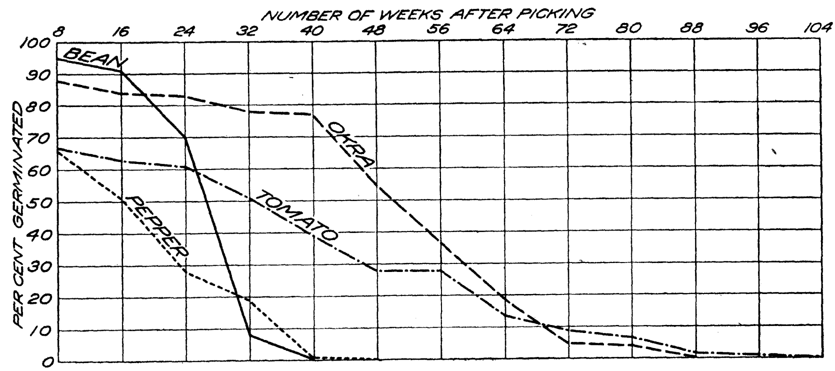

FIG. 11.—Loss of viability of home-grown vegetable seed exposed to the open air. The okra curve was made from the averages of 10 different lots of seed, the tomato curve from 6, the bean curve from 5, and the pepper curve from 3. Since the ripening season in many instances extended over a period of a number of weeks, the picking date was arbitrarily assumed and the tests were therefore only approximately so many weeks after picking.

that the growth and production of the advanced generations are not inferior to those of the earlier ones.

The development of plants of the different generations of tomatoes grown in Porto Rico was very uniform and proves that, except for occasional importations, the seed of this vegetable needed in Porto Rico can well be grown in the home gardens.

In the work with lettuce no degeneration was noted as a result of growing an imported variety for successive generations in Porto Rico. Owing to the difficulty of producing seed during seasons of heavy rain, the experiments with this crop were hindered considerably. As seed production is difficult and loss of viability rapid, it will probably be necessary to import the seed of this crop.

In all vegetable plantings the season at which the planting was made had a very pronounced effect on the yield, being the predominant factor influencing production.

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