

Blueberries

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Some Results of Self-Pollination of the Highbush Blueberry at Whitesbog, New Jersey¹

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THE senior author, from 1911 to 1928, worked in close association with Dr. F. V. Coville of the United States Department of Agriculture, supplying him with selected wild bushes which constituted the major portion of his blueberry breeding stocks. During this period she had charge of approximately 35,000 seedlings which were tested for the Department at Whitesbog, more than 90 per cent of all produced by Dr. Coville up to 1928. In 1928, the senior author began independent blueberry breeding, the number of different crosses made from 1928 to 1937 being 298, and the number of seedlings produced from these crosses 147,000. The objective of the breeding work at Whitesbog has been the development of better commercial varieties of blueberries.

Dr. Coville (3) has stated, "When blueberry flowers are pollinated with pollen from their own bush the berries are fewer, smaller, and later in maturing than when the pollen comes from another bush. Some bushes are almost completely sterile to their own pollen . . . It is important, therefore, that a plantation should not be made up wholly from cuttings from one bush."

The senior author's extensive field observations had lead her to concur fully with Dr. Coville. In consequence no thought was given to the desirability of experimenting with self-pollination until the question was raised by the work of Merrill (4) who concluded that "self-pollination gives satisfactory commercial sets in those varieties of highbush blueberry investigated." In order to determine the self-fertility of certain varieties at Whitesbog, a number of those which were being used in the breeding program were self-pollinated in 1937. As Rubel was not included among these, it and several other varieties were self-pollinated in 1938.

METHODS

The breeding work at Whitesbog has all been done on bushes in the open field. The method employed in protecting the blossoms from contamination by undesired pollen was as follows. The clusters to be pollinated were selected after the first few flowers had opened and all open flowers were removed with forceps. Each cluster was then covered with a manilla paper bag which was folded closely about the stem, secured by large pins through the folds, and left in place for 3 to 5 days before the crosses were made.

Pollen was collected from bagged flowers or from flowering stems kept in water in the house where blossoms continued to open for several

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days. The open flowers were gently removed from the stems with curved forceps. The pollen was collected in No. 1 gelatine capsules by twirling the blossom between the thumb and forefinger over the open capsule. Some flowers yielded a perceptible shower of pollen and by twirling many flowers sufficient pollen was secured to fill the capsule to a depth of $\frac{1}{16}$ to $\frac{1}{8}$ inch. When pollen from one variety was to be used on several seed parents a separate capsule of pollen was collected for each. This is a safeguard against accidents of which, when working outdoors, high winds are the most frequent cause. The capsules of pollen were placed in marked envelopes, the envelopes placed in a covered jar, and the jar in a refrigerator. Pollen thus kept dry and cold will retain its viability for a considerable period. The senior author has used it with good results after it has been in the refrigerator for a week, and was told by Dr. Coville that he had secured good results with pollen more than a month old.

When each pollination was made the bag was removed from the cluster, all small buds were picked off with the forceps, and the corolla and stamens were removed with the same instrument. The pollen from the capsule was then applied with a tiny spatula made by flattening the wire of a paper clip. It has seemed desirable to place the pollen on the stigma with a definite though gentle pressure.

When weather is favorable for the secretion of nectar, bees will continue to visit blueberry blossoms for at least 2 days after the removal of the corolla and stamens. Therefore, after the pollination of each cluster was completed the bag was again fastened over it and left for 3 or 4 days. It was then removed to permit the normal growth of the leafy shoots surrounding each cluster of flowers.

When the berries were nearly ripe, they were covered again to prevent their being taken by birds or knocked off by high winds. By this time the leafy shoots had grown so long that it was impractical to cover the clusters with bags similar to those used at the time of pollination. Instead it has been found convenient to use pieces of fine mosquito netting, secured about each cluster by pins. This method protects the hand pollinated berries from the hazards mentioned above but does not secure them against occasional attacks by insects or infection by mummy berry fungus. Without the protection afforded by the netting a large percentage of the berries of early varieties hand pollinated in 1938 would have been lost.

The results of self- and cross-pollination with certain varieties are shown in Table I. The berries were classified as to size by being placed on a metal gauge, those which rested on the 20 millimeter hole in the gauge being placed in the first group while those which dropped through the 20 millimeter hole but rested on the 19 millimeter hole were classified as 19 millimeter. The seeds in the berries resulting from certain self-pollinations were counted, whereas in others the seeds were planted and the resulting seedlings only were counted. Seeds from the berries resulting from cross-pollination were planted and the resulting seedlings only were counted.

The data in Table I indicate that, in many cases at least, the percent of total flowers self-pollinated which set fruit was not significantly

TABLE I—PER CENT SET, SIZE OF BERRIES, AND NUMBER OF SEEDS, OR SEEDLINGS FROM SELF- AND CROSS-POLLINATIONS AT WHITESBOG, NEW JERSEY

Cross	Flowers Pollinated	Set (Per Cent)	Number of Berries in each Size Class; (Mm.)								Number of Seedlings			
			20	19	18	17	16	15	14	13		13-		
<i>1937 Pollinations</i>														
Sam ×self.....	27	48.1									139s*			
Sam ×Grover.....	73	79.5				1	1	4	4	4	2	1520		
						1	1	19	11	12	5	9		
Grover ×self.....	5	100.0										0		
Grover ×Sam.....	53	69.8				4	9	4	7	5	2	6	300	
Harding ×self.....	36	0.0											0	
Harding ×Haines No. 4.....	82	50.0	3	8	5	6	7	8	3	1	22		840	
Haines No. 4 ×self.....	28	89.3											110s	
Haines No. 4 ×Harding.....	72	66.7						5	22	10	3	9	13	1000
Haines No. 4 ×Brooks.....	65	56.9						4	8	8	7	10		300
Brooks ×self.....	23	43.5												19s
Brooks ×Haines No. 4.....	55	74.5						1	5	12	6	17		300
Concord ×self.....	18	66.7						3	2	2	2	1	2	44
Concord ×29-17A.....	104	92.3				25	17	25	8	3			18	2031
1552H ×self.....	24	66.7												16
1552H ×29-17A.....	49	67.3				1	7	9	7	2	2	2	5	595
1552H ×1613A.....	77	71.4				1	18	19	4	5	8			1102
1552H ×1239E.....	59	67.8				1	2	5	11	4	6	11		355
Stanley ×self.....	24	87.5							3	6	4	3	5	4
Stanley ×2505A.....	114	84.2	16	17	13	16	4	3	1	26				706
Stanley ×29-17A.....	106	85.8	1	4	26	20	12	5		23				1640
Stanley ×29-28B.....	86	95.3	2	13	25	23	8	6	4					540
Stanley ×29-28A.....	73	71.2	1	1	5	5	24	10	6					374
1239E ×self.....	31	39.0												12
1239E ×1552H.....	65	93.8				5	6	14	8	13	15			300
1239E ×Jersey.....	52	90.4				6	11	4	8					264
1239E ×1437C.....	67	80.6	3	6	13	16	7	2						1110
1239E ×1617H.....	85	74.1	1	11	14	21	7	3	3	3				550
1239E ×2505F.....	95	72.6	7	23	21	9	3							1022
1239E ×2505A.....	132	93.9	1	6	20	32	18	10	11	3	23			1580
1437C ×self.....	21	61.9												13
1437C ×29-17A.....	66	63.6												1
1437C ×1239E.....	42	69.0				2	10	6	5	3	1	1		1
<i>1938 Pollinations</i>														
Rubel ×self.....	42	71.4							4	4	14	6	6	—
Rubel ×1552H.....	36	63.9							9	9	4	1		—
1613A ×self.....	36	94.4						1	7	7	1	6	12	—
1613A ×28-8A.....	71	81.7	2	6	21	5	1							6
1613A ×29-39D.....	82	100.0				8	22	6	1	6				14
1613A ×29-39C.....	69	73.9				4	8	5	5	1				14
1613A ×29-39B.....	74	78.4						16	12	8	4			2
1613A ×29-39A.....	59	89.8				4	12	9	6					5
1613A ×Stanley.....	79	81.0				8	10	8	4	1				5
1613A ×1552H.....	76	72.4						10	10	9	9			—
2505A ×self.....	34	73.5				2	1	4	7	3				8
2505A ×1613A.....	76	86.8	3	10	12	18	7	4	3					9
2505A ×28-8A.....	58	77.6	4	3	8	8	12	3	2					5

*s, seed count, seeds not planted
 †B.D., berries discarded, seeds not counted.

different from the per cent set with cross-pollination. In all of the progenies, however, with the possible exception of 1437C selfed compared with 1437C x 29-17A, the berries resulting from self-pollination were distinctly smaller than those resulting from cross-pollination and

were usually too small to be considered of commercially desirable size. Furthermore, the small berries resulting from self-pollination were usually still green at the time when the large berries resulting from cross-pollination were ripe.

Merrill (4) stated that he found no relationship between size of berry and number of seeds. In this connection there are presented some data secured by the senior author in 1935. Fruit from three different crosses was picked on July 3, and the berries classified according to size. The seeds from the berries of each size class were washed out separately. When sufficiently dry to handle, the seeds of each group were divided, with the aid of a small magnifying glass, into "Large" and "Small" and counted, the results being shown in Table II. After being counted the "Large" and "Small" seeds from each pollination were planted making two groups for each cross.

TABLE II—NUMBER OF SEEDS IN BLUEBERRIES OF DIFFERENT SIZES, POLLINATIONS OF 1935, WHITESBOG, NEW JERSEY

Cross	Number of Berries	Diameter (Mm)	Average Number Large Seeds per Berry	Average Number Small Seeds per Berry	Average Number of Seeds per Berry
1437C × Haines No. 4	2	20	27.5	27.5	55.0
	6	19	26.0	37.0	63.0
	9	18	27.8	33.1	60.9
	11	17	20.0	38.1	58.1
	3	16	15.0	40.7	55.7
1437C × 2506B	6	16	10.8	30.8	41.7
	1	19	22.9	45.1	68.0
	6	18			
	16	17	21.9	33.7	55.6
	10	16	14.5	43.0	57.5
1437C × 2505A	3	16	8.3	25.0	33.3
	2	18	24.8	30.9	55.7
	9	17			
	9	16	17.7	21.2	38.9
	7	15			

It is evident from the data in Table II that, in these crosses at least, the larger berries contained more seeds. It would seem logical to think, therefore, that anything, such as better pollination, which might tend to increase the average number of seeds per berry would also tend to increase the average size of berries.

Counts made in April of 1936 showed that, from the cross 1437C x Haines No. 4, the 791 large seeds had produced 474 plants, whereas 1,301 small seeds gave only 450 plants. Plants from the large seeds were about 15 per cent larger at this time than the plants from the small seeds. From the cross 1437 x 2506B, the 680 large seeds produced 630 plants whereas 1,361 small seeds gave 559 plants which were slightly smaller than plants from the large seeds.

DISCUSSION

The results obtained in these experiments agree with the findings of Coville (3) and Beckwith (2), that self-pollinated blueberries are smaller and later in maturing than the berries resulting from cross-pollination. Bailey (1) compared self-pollination with open-pollination of a number of varieties in Massachusetts, during three different seasons, and stated that Rubel gave the best performance when self-

pollinated but that in none of the three seasons was a satisfactory commercial crop produced. He also found that there was a tendency, for certain varieties at least, to set small berries when self-pollinated.

On the other hand, the data presented in this paper are not in agreement with the results of Merrill (4) who reported that, under conditions in Michigan, Rubel, Cabot, Adams, and Pioneer were sufficiently self-fruitful to give a satisfactory crop although in most cases a slightly better set was secured by cross-pollination. Furthermore, Merrill found the selfed berries to be as large in every case as the crossed berries and that they matured in their normal season. The differences between the results secured by Merrill and those reported in this paper might possibly be explained on the basis of different environmental conditions or varietal differences. The only variety used in both experiments was Rubel, which gave especially good yields when self-pollinated in Michigan. In New Jersey, Rubel selfed gave a good set but smaller size and later maturity than when it was cross-pollinated, although the number of pollinations was not large.

From the evidence presented in this paper it would seem advisable, under New Jersey conditions at least, to provide for adequate cross-pollination in blueberry plantings. In most of the crosses there was a satisfactory set and normal size regardless of the kind of pollen used. There is an indication of incompatibility, however, in the cross 1437C x 29-17A. In the cross 1239E x 1552H the resulting berries were slightly smaller than where other pollen varieties were used and they were distinctly slower in ripening, possibly indicating some degree of incompatibility. There is a possibility, therefore, that two varieties planted together to insure cross-pollination might prove to be incompatible but most varietal combinations would probably be satisfactory from the standpoint of pollination.

SUMMARY

The set obtained by self- and cross-pollination of flowers of several blueberry varieties and the size of the resulting berries were studied. A poor set was obtained from certain self-pollinations but on the average the per cent was about as good from self- as from cross-pollinations. The berries resulting from self-pollination were consistently smaller than those resulting from cross-pollination and in some cases remained hard and green for several days after the larger, cross-pollinated fruits had ripened. The large berries of certain crosses studied contained more seeds than the smaller berries, the number of large seeds being roughly proportional to the size of the berry.

LITERATURE CITED

1. BAILEY, J. S. The pollination of the cultivated blueberry. *Proc. Amer. Soc. Hort. Sci.* 35: 71-72. 1938.
2. BECKWITH, C. S. Report of Department of Entomology. *N. J. Agr. Exp. Sta.* p. 174. 1930.
3. COVILLE, F. V. Directions for blueberry culture. *U. S. D. A. Bul.* 974. 1921.
4. MERRILL, T. A. Pollination of the highbush blueberry. *Mich. Agr. Exp. Sta. Tech. Bul.* 151. 1936.