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PRUNING THE Highbush BLUEBERRY

By W. T. BRIGHTWELL and STANLEY JOHNSTON

MICHIGAN STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
SECTION OF HORTICULTURE

East Lansing

Pruning the Highbush Blueberry

By W. T. BRIGHTWELL and STANLEY JOHNSTON

THE RISE IN IMPORTANCE of the cultivated blueberry industry has greatly increased the need for specific data on pruning. Many recommendations have been given, based only on apparent response of plants to various methods of pruning; however, very few data are available to substantiate these recommendations.

Because of present-day competition of wild blueberries and other fruits and the increasing production of cultivated blueberries, the grower must follow practices which net him the greatest profit. Pruning is almost universally recommended to increase the size of berries, but its influence on yield and time of ripening is usually not discussed.

REVIEW OF LITERATURE

Blueberry pruning was mentioned as early as 1916 by Coville (1). He stated that with suitable pruning a blueberry plant will live as long as a man, or longer.

There were some differences of opinion among early workers concerning the pruning of the swamp or highbush blueberry. Coville (2) in 1921 stated that a yearly pruning of the swamp blueberry is not necessary, although he states that unproductive stems should be cut to the ground. White (3) in 1921 maintained that although little is definitely known about pruning, the practice is desirable. Mowry and Camp (4) observed that a severe heading back of old plants of the southern rabbiteye blueberry gave an increased yield the second or third year after the heading back.

Many workers, including Bailey (5); Bailey, Franklin and Kelley (6); Beckwith, Coville and Doehlert (7); Crowley (8); Johnston (9); and Latimer and Smith (10), have indicated that pruning is one of the most important operations in the culture of the highbush blueberry. Beckwith, Coville, and Doehlert (7) place pruning above all other cultural practices by saying that pruning is the largest single factor in producing fancy fruits.

Mowry and Camp (4) have stated that to prune a blueberry plant properly, it must be studied from the standpoint of vigor and fruit-bud distribution. Fruit buds on the dormant blueberry plant are found on mature wood of the previous season's growth. They are produced

in the axils of leaves, mainly on the terminal portion of laterals, and on primary shoots in some instances.

Pruning recommendations of some of the more recent investigators are very similar. Bailey, Franklin and Kelley (6); Crowley (8); and Beckwith, Coville and Doehlert (7) recommend (a) the removal of about one-third of the oldest stems each year after the plant is in full production, and (b) the reduction of the number of fruit buds on varieties that normally set fruit buds very heavily, such as Pioneer, Sam, Harding, Katherine, and Cabot by a tipping-back of the fruiting laterals.

Working with the Rubel variety, Johnston (9) used four plots of ten plants each in a series of pruning studies. Fine wood was removed from plants in the first plot; plants in the second plot had the fine wood removed and about one-third of the oldest stems were headed back one-third; in the third plot, the fine wood was removed and about one-third of the old stems were headed back severely; and, the fourth plot (check) received no pruning. This experiment indicated that the type of pruning given in the second plot, in which the fine wood was removed and part of the oldest shoots headed back moderately each year, should maintain satisfactory yields and size of fruit over a long period of years.



Fig. 1. Examples of bushy thin wood of Rubel (left) and Pioneer (right).



Fig. 2. Full-grown Rubel bush unpruned for two years.

MATERIALS AND METHODS

The experiments reported in this paper were carried out during the seasons of 1939-42, inclusive, at the South Haven Experiment Station plantation near South Haven, Michigan.

A uniform group of plants of the Rubel and Pioneer varieties, which had been set in the field in 1929, was selected. The plants were set 4 feet by 9 feet on a fairly uniform Saugatuck sandy loam soil, well supplied with organic matter. This soil was somewhat more productive

than that in the average Michigan blueberry plantation. The plants had received a moderate pruning each year before this experiment was initiated and an application of a specially prepared 5-8-10 fertilizer since the second season in the field. Clean cultivation was practiced each season until harvest.

In order to facilitate a clearer understanding of the terminology used in this paper to designate the different parts of the plant, the following terms are defined:



Fig. 3. Full-grown Pioneer bush, unpruned for two years.



Fig. 4. Lightly pruned Rubus bush.

SHOOT—new growth originating at or near the base of the plant the previous season.

STEM—shoot growth more than one year old.

LATERAL—fruiting wood of the past season's growth other than shoot growth.

BUSHY THIN WOOD—dense, weak, branching, lateral growth. (Fig. 1.)

Two very heavy frosts which occurred in the spring of 1938 killed many blueberry blossoms and reduced the fruit crop that season. This reduction in crop resulted in a moderate-to-vigorous vegetative growth and the formation of many fruit buds. Consequently, the plants at the beginning of this experiment were in good condition for the production of large yields.

Rainfall was above normal three of the four years for the three months of June, July and August. As shown in Table 1, the 1939 rainfall for the three months was 10.82 inches, which was 1.67 inches above



Fig. 5. Lightly pruned Pioneer bush.

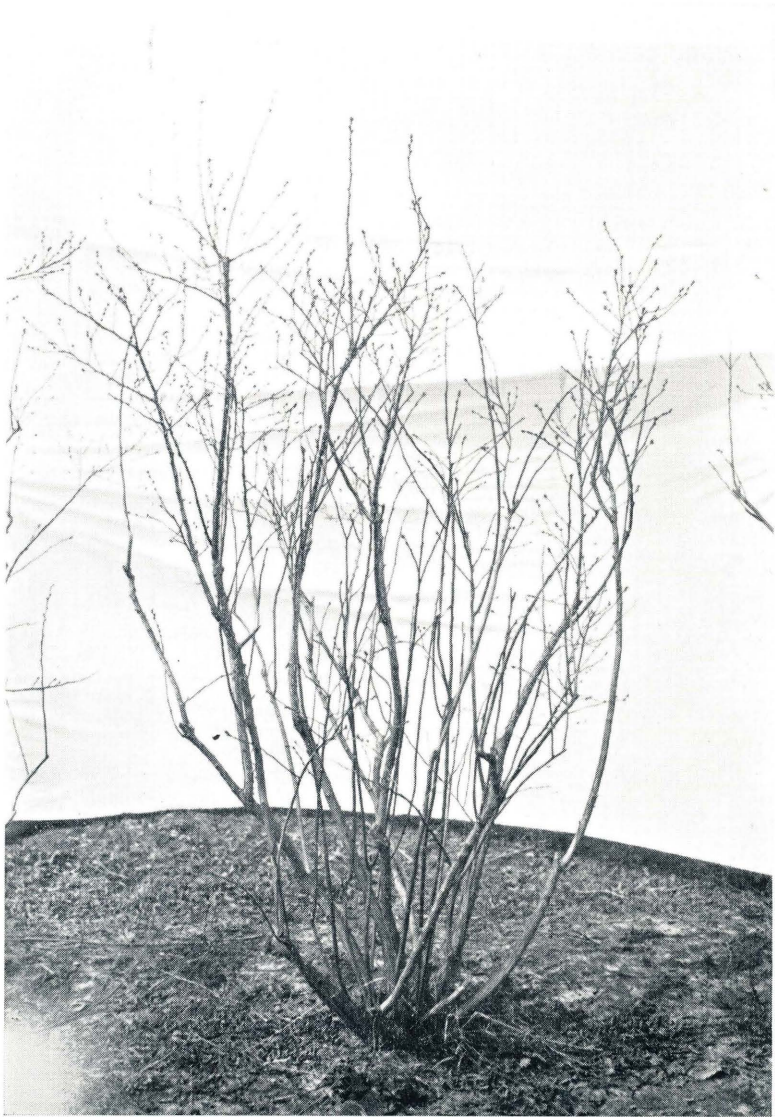


Fig. 6. Rubus bush after receiving an intermediate pruning.

normal; the 1940 rainfall for this period was 13.01, which was 3.86 inches above normal; the three months' period of 1941 had the lowest rainfall, 6.09 inches, which was 3.06 inches below normal; the total rainfall for the three months' period in 1942 was 13.51 inches, which was 4.36 inches above normal. This heavy rainfall was especially favorable to the unpruned plants which had a large leaf area and a very large crop of fruits.

GENERAL PRUNING METHODS

Nine plots of ten plants each were used for a comparison of different degrees of pruning from no pruning to heavy pruning. Five of these plots were of the Rubel variety and four were of the Pioneer variety. One plot of each variety received the following treatments each year:

CHECK—no pruning (Figs. 2 and 3).

LIGHT PRUNING—removal of bushy thin wood and light heading back of new shoots (Figs. 4 and 5).



Fig. 7. Pioneer bush after receiving an intermediate pruning.



Fig. 8. Rubus bush pruned moderately heavy.

INTERMEDIATE PRUNING—removal of bushy thin wood, about one-third of the oldest stems, and moderate heading back of new shoots (Figs. 6 and 7).

HEAVY PRUNING—removal of bushy thin wood and at least one-third of the oldest stems, heading back of all new shoots, and reducing the number of fruit buds on fruiting laterals about 60 percent by heading back each lateral (Fig. 9).



Fig. 9. Pioneer bush pruned heavily.

TABLE 1—Rainfall for the months of June, July and August, 1939-42

Year	June		July		August		Total departure from normal
	Rainfall in inches	Departure from normal	Rainfall in inches	Departure from normal	Rainfall in inches	Departure from normal	
1939	5.93	+2.12	1.94	-0.68	2.95	+0.23	+1.67
1940	3.81	0	1.34	-1.28	7.86	+5.14	+3.86
1941	2.27	-1.54	1.72	-0.90	2.10	-0.62	-3.06
1942	4.22	+0.41	3.45	+0.83	5.84	+3.12	+4.36

The plants of one plot of the Rubel variety received a moderately heavy pruning. This pruning was identical to the heavy pruning except the number of fruit buds was not reduced by heading back of the laterals (Fig. 8). The berries were picked and weighed at various intervals as they reached maturity. Comparative size was determined by counting the berries required to fill a half-pint liquid measuring cup. The size grades adopted are those used by the Michigan Blueberry Growers' Association. These grades are: Superior, 90 berries or fewer per cup; Golden Moon, 91 to 140 berries per cup; Columbia, 141 to 190 berries per cup; and Lake State, more than 190 berries per cup.

TABLE 2—Effects of pruning on average yield of plants and size of berries of the Rubel variety

Treatment	Picking	Average weight of berries per plant (ounces)				Average number of berries per grading cup				Four-year average
		1939	1940	1941	1942	1939	1940	1941	1942	
Check—no pruning	1.....	122.9	68.5	111.5	117.0	157	131	213	132	158
	2.....	132.5	96.2	138.4	93.1	209	163	338	145	214
	3.....	80.3	91.9	87.5	76.8	215	202	313	153	221
	4.....	31.6	51.2	42.3	11.5	256	195	344	198	248
	5.....	9.3	11.4	15.8	.....	274	216	367	.....	286
	6.....	.....	2.0	.....	.....	.....	.....	.....	.....	.....
	Total..	376.6	321.2	395.5	298.4	Ave. 222	181	315	157	219
Light pruning	1.....	172.9	63.5	156.6	117.4	141	143	166	130	145
	2.....	76.2	111.5	90.7	114.3	176	183	192	145	174
	3.....	23.8	87.4	32.0	105.0	201	224	256	155	209
	4.....	5.1	42.8	6.2	13.1	243	220	229	201	223
	5.....	1.6	10.7	5.5	.....	301	251	240	.....	264
	6.....	.....	2.9	.....	.....	.....	.....	.....	.....	.....
	Total..	279.6	318.8	291.0	349.8	Ave. 189	204	217	158	189
Intermediate pruning	1.....	152.2	61.7	57.3	111.2	129	135	152	128	136
	2.....	61.8	89.3	109.2	94.0	174	167	160	142	161
	3.....	17.7	65.8	67.0	85.0	185	192	213	151	185
	4.....	4.6	23.7	8.4	7.1	230	225	212	183	212
	5.....	1.2	7.2	8.2	.....	228	241	228	.....	232
	6.....	.....	1.3	.....	.....	.....	.....	.....	.....	.....
	Total..	237.5	249.0	250.1	297.3	Ave. 174	192	193	151	177
Moderately heavy pruning	1.....	101.0	39.6	30.9	53.0	118	131	124	115	122
	2.....	18.4	54.2	88.3	77.5	156	160	129	128	143
	3.....	1.7	26.5	27.9	38.9	219	217	142	152	182
	4.....	.3	7.1	7.2	1.6	.....	.....	166	.....	166
	5.....	.1	.8	1.2	.....	.....	.....	.....	.....	.....
	6.....	.....	.3	.....	.....	.....	.....	.....	.....	.....
	Total..	121.5	128.5	155.5	171.0	Ave. 164	169	140	132	151
Heavy pruning	1.....	58.3	51.5	44.1	58.6	100	108	137	104	112
	2.....	3.4	62.7	72.9	69.1	145	136	155	113	137
	3.....	.4	26.2	28.9	18.9	190	159	187	136	168
	4.....	.2	3.9	2.0	.8	.....	178	.....	.....	178
	5.....	.1	.7	1.3	.....	.....	.....	.....	.....	.....
	6.....	.....	.3	.....	.....	.....	.....	.....	.....	.....
	Total..	62.4	145.3	149.2	147.4	Ave. 145	145	160	118	142

INFLUENCE OF PRUNING ON YIELD

As the plants used in this experiment had received only a moderate pruning each year previous to this experiment, they contained considerable amounts of small bushy wood. Since the check or unpruned plants received no pruning, they possessed a large bearing capacity. The production of a large crop of fruit the first year of the experiment on the unpruned plants resulted in a reduction of growth of fruiting wood, thereby reducing the crop the next year. This tendency to bear heavier crops one year and lighter crops the next was noticeable in both the unpruned and lightly pruned plants and not apparent in the heavier pruned plants.

Data on the influence of the various pruning treatments for each year of the experiment for the Rubel variety are shown in Table 2 and for the Pioneer variety in Table 3.

TABLE 3—*Effects of pruning on average yield of plants and size of berries of the Pioneer variety*

Treatment	Picking	Average weight of berries per plant (ounces)				Average number of berries per grading cup				Four-year average
		1939	1940	1941	1942	1939	1940	1941	1942	
Check—no pruning	1.....	15.5	31.2	85.6	84.5	122	121	138	117	124
	2.....	51.3	59.5	149.4	87.0	144	103	160	114	130
	3.....	91.9	74.8	97.3	149.5	160	114	185	132	148
	4.....	121.5	96.6	75.9	77.6	178	141	209	140	167
	5.....	70.0	37.5	21.3	73.3	217	156	254	149	194
	6.....	44.5	30.7	.....	8.6	228	161	.....	208	199
	7.....	10.9	.....	.....	.....	283	.....	.....	.....	283
	Total..	405.6	330.3	429.5	480.5	Ave. 190	132	189	143	164
Light pruning	1.....	13.4	38.2	58.7	74.5	113	121	130	112	119
	2.....	50.7	55.7	102.4	68.0	126	105	145	115	123
	3.....	93.5	75.0	95.2	125.9	134	123	159	133	137
	4.....	81.1	78.5	47.1	72.4	156	140	200	142	160
	5.....	37.9	25.4	6.9	54.3	170	164	230	157	181
	6.....	14.9	28.2	.....	10.3	244	165	.....	207	205
	7.....	2.6	.....	.....	.....	270	.....	.....	.....	270
	Total..	294.1	301.0	310.3	405.4	Ave. 173	136	173	145	157
Intermediate pruning	1.....	13.5	46.1	51.1	75.7	116	113	123	118	118
	2.....	60.9	41.2	84.9	61.9	122	105	130	119	119
	3.....	109.9	52.5	64.9	121.0	128	119	133	126	127
	4.....	66.0	29.7	31.7	33.9	146	138	170	158	153
	5.....	23.4	4.1	4.7	33.0	174	174	196	167	178
	6.....	5.0	2.6	.....	3.3	228	.....	.....	209	219
	7.....	3	.....	.....	.....	.....	.....	.....	.....	.....
	Total..	279.0	176.2	237.3	328.8	Ave. 151	130	150	150	145
Heavy pruning	1.....	5.7	45.0	50.8	73.6	82	87	103	107	95
	2.....	46.0	45.5	85.7	50.3	82	87	108	101	95
	3.....	33.8	59.4	55.4	56.7	84	96	106	114	100
	4.....	7.4	21.0	10.2	5.8	94	115	134	169	128
	5.....	4	1.8	1.2	2.0	.....	.....	.....	161	161
	6.....	.1	.3	.....	.....	.....	.....	.....	.....	.....
	7.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Total..	93.4	173.0	203.3	188.6	Ave. 85	99	113	130	116

The data presented in Table 4, which is a summary of the four-year experiment, show that the unpruned plants of the Rubel variety produced the largest average yield for the four-year period, or 352.5 ounces per year. The plants receiving a light pruning produced an average yield of 313.5 ounces, or 88.9 percent of the yield of the unpruned plants. The plants which received the intermediate pruning averaged 260.9 ounces per plant for the four-year period. This was 74.0 percent of the yield of the unpruned plants. The plants receiving the moderately heavy pruning yielded an average of 144.6 ounces per plant which was only

TABLE 4—Four-year average total yield, yield of each picking and percentage of total yield harvested at each picking per plant

Treatment	Picking	Pioneer		Rubel	
		Average weight of berries in ounces	Percent of average total yield	Average weight of berries in ounces	Percent of average total yield
Check—no pruning	1.....	54.2	12.7	105.0	29.7
	2.....	86.8	20.4	115.1	32.6
	3.....	103.4	24.2	84.1	23.9
	4.....	92.9	21.8	34.1	9.7
	5.....	50.5	11.8	12.2	3.5
	6.....	27.9	6.5	2.0	.6
	7.....	10.9	2.6	.....	.....
	Total.....	426.6	100.0	352.5	109.0
Light pruning	1.....	46.2	13.8	127.6	40.7
	2.....	69.2	20.7	98.2	31.3
	3.....	97.4	29.2	62.1	19.8
	4.....	69.7	20.9	16.8	5.4
	5.....	31.1	9.3	5.9	1.9
	6.....	17.8	5.3	2.9	.9
	7.....	2.6	.8	.....	.....
	Total.....	334.0	100.0	313.5	100.0
Intermediate pruning	1.....	46.6	18.2	95.6	36.6
	2.....	62.2	24.3	88.6	34.0
	3.....	87.0	33.9	58.9	22.6
	4.....	40.3	15.7	11.0	4.2
	5.....	16.3	6.4	5.5	2.1
	6.....	3.6	1.4	1.3	.5
	7.....	3	.1	.....	.....
	Total.....	256.3	100.0	260.9	100.0
Moderately heavy pruning	1.....	.....	.....	56.1	38.8
	2.....	.....	.....	59.6	41.2
	3.....	.....	.....	23.8	16.5
	4.....	.....	.....	4.1	2.8
	5.....	.....	.....	.7	.5
	6.....	.....	.....	.3	.2
	7.....	.....	.....	.....	.....
	Total.....	.....	.....	144.6	100.0
Heavy pruning	1.....	43.7	26.6	53.1	42.0
	2.....	56.9	34.5	52.0	41.1
	3.....	51.3	31.2	18.6	14.7
	4.....	11.1	6.8	1.7	1.3
	5.....	1.3	.8	.7	.6
	6.....	.2	.1	.3	.2
	7.....	.....	.....	.....	.....
	Total.....	164.5	100.0	126.4	99.9

41.0 percent of the yield of the unpruned plants. The plants which received the heavy pruning averaged 126.4 ounces per plant which was only 35.9 percent of the yield of the unpruned plants.

Each of the pruned plots produced the lowest yields of the four-year period during the first season. This was due to the fact that the removal of the thin bushy wood reduced the fruiting area in proportion to the severity of pruning. The plants which received a light pruning averaged 279.6 ounces the first season compared with the heavily pruned plants which averaged only 62.4 ounces per plant (Table 2).

After the first season the yield of the pruned plants was more uniform than that of the unpruned plants. The average yield of the unpruned plants was larger each year except for the season of 1942 when the check plants averaged 298.4 ounces, the plants given a light pruning averaged 349.9 ounces, and the plants given an intermediate pruning averaged 297.3 ounces (Table 2).

The results of the different pruning methods on plants of the Pioneer variety were similar to those obtained on the Rubel variety. Table 4 shows that the unpruned plants of the Pioneer variety produced an average of 426.6 ounces of berries per year for the four years of the experiment. The plants which received a light pruning produced an average of 334.0 ounces which was 78.2 percent of the yield of the unpruned plants. The plants which received an intermediate pruning produced an average of 256.3 ounces per plant, this being 60.1 percent as much as the unpruned plants. The plants which received a heavy pruning produced an average of 164.5 ounces, or 38.6 percent as much as the unpruned plants.

The smallest yield produced under any treatment on the Pioneer variety was an average of 93.4 ounces per plant produced by heavily pruned plants in 1939 (Table 3). The largest yield was an average of 480.5 ounces per plant produced by the unpruned plants in 1942.

INFLUENCE OF PRUNING ON SIZE OF BERRIES

The size of berries produced on plants of the Rubel variety receiving the different methods of pruning is shown in Table 2. The number of berries required to fill a one-half pint liquid measuring cup was used as a basis for comparison. The larger the number the smaller the berry size. When possible, the berries required to fill one cup were counted from each plant at each picking and the average taken as the representative size.

Berries were larger at the early picking than at the later pickings in the season. The largest berries of the Rubel variety were harvested the first season from plants which had received a heavy pruning. At this picking, 100 berries were required to fill a grading cup.

Berry size increased as severity of pruning was increased. The average number of berries per grading cup for the four-year period for the different methods of pruning are as follows: unpruned plants, 219; plants which received a light pruning, 189; plants receiving an intermediate pruning, 177; plants which received a moderately heavy pruning, 151; and those which received a heavy pruning, 142 (Table 2).

The heavily and moderately heavily pruned plants produced berries of a more uniform size than the unpruned and lightly pruned plants. The unpruned plants produced comparatively large berries one year and smaller berries the following year. The extremities of variation in the average number of berries per grading cup produced on plants under different treatments was as follows: unpruned plants, 315 in 1941 to 157 berries per cup in 1942; plants which received a light pruning, 217 in 1941 to 158 in 1942; plants which received an intermediate pruning, 193 in 1941 to 151 in 1942; plants which received a moderately heavy pruning, 169 in 1940 to 132 in 1942; and plants which received a heavy pruning, 160 in 1941 to 118 berries per cup in 1942 (Table 2).

It may be noted that the smallest berries were produced in 1941 in four out of five treatments. Table 1 shows that rainfall for the months of June, July, and August was 3.06 inches below normal, which no doubt is the reason for the reduction in size of berries during the 1941 season.

Pruning did not increase the size of berries of the Pioneer variety as much as the Rubel variety, nor were the results as uniform from year to year (Table 3). The size of the berries increased as the severity of pruning increased the first and third seasons. The second- and fourth-season berries from unpruned plants averaged slightly larger than those from plants which had received a light pruning. The fourth-season berries from the unpruned and lightly pruned plants averaged slightly larger than those which received an intermediate pruning.

Despite greater seasonal variation in the case of the Pioneer variety, the average number of berries required to fill a grading cup for the four-year period decreased as severity of pruning increased. The average number of berries required to fill a measuring cup was 164, 157, 145, and 116 for plants receiving no pruning, light, intermediate and heavy pruning, respectively. Comparing these counts with those for Rubel, it is evident that Pioneer produces larger sized berries on the average under all pruning treatments than Rubel.

INFLUENCE OF PRUNING ON TIME OF MATURITY

Data presented in Table 4 indicate that the more severe the pruning the greater the percentage of berries harvested in the early pickings. The unpruned plants of the Rubel variety matured 86.2 percent of

their berries the first three pickings. The plants which received a light pruning matured 91.8 percent of their berries the first three pickings. The plants which received an intermediate pruning matured 93.2 percent of their berries the first three pickings. The plants receiving a moderately heavy pruning matured 96.5 percent of their berries the first three pickings. The plants which received a heavy pruning matured 97.8 percent of their berries the first three pickings. As was the case with the Rubel variety, the unpruned plants of the Pioneer variety matured their berries later than the heavily pruned plants. The unpruned plants matured 57.3 percent of their average yield the first three pickings, the plants receiving a light pruning matured 63.7 percent, the plants which had an intermediate pruning matured 76.4 percent, and the heavily pruned plants matured 92.3 percent of their average yield (Table 4).

It may be noted that severe pruning influenced the time of maturity of the Pioneer variety to a much greater extent than the Rubel variety. The Pioneer responded to the heavy pruning by producing a much more vigorous growth. The Rubel variety did not respond so readily to heavy pruning and did not produce such strong vigorous fruiting shoots.

INFLUENCE OF PRUNING ON COMPARATIVE RETURNS

The price of blueberries received by the grower varies throughout the season. Late berries, even though small, have returned Michigan growers much larger prices than large early berries. For example, the gross selling price of berries received by the Michigan Blueberry Growers' Association for the Golden Moon grade was 13.4 cents per pint July 2-7, 1939, compared with 23.0 cents per pint for berries of the Lake State grade August 26 to September 1 of the same season. This is due largely to the fact that early Michigan berries arrive on the market at the same time as berries from New Jersey, and to heavy competition from other fruits, such as strawberries, raspberries and cherries, which are plentiful on the market during the first part of the Michigan blueberry season.

The 1939 gross returns may be used as an index to show a comparison of returns for the four-year period. Table 4 shows the average yield at each picking and the percentage of the crop harvested at each picking. The average number of pints harvested at each picking was calculated, and the gross price received by the Michigan Blueberry Growers' Association was used to calculate returns. The average gross returns of plants of the Rubel variety which received a light, intermediate, moderately heavy and heavy pruning were 91.9, 82.1, 45.2 and 38.7 percent, respectively, of the gross returns received from unpruned plants.

The average gross returns of plants of the Pioneer variety which received light, intermediate and heavy pruning were 78.8, 59.0 and 33.7 percent, respectively, of the gross returns received from unpruned plants.

SUPPLEMENTARY EXPERIMENTS TO DETERMINE THE
EFFECT OF VARIOUS TREATMENTS ON YIELD, SIZE
AND TIME OF MATURITY OF BERRIES

In addition to the information already presented and which was obtained from the ten-plant plots of Rubel and Pioneer on the effect of various amounts of pruning on the yield, size and time of maturity of berries, several supplementary tests were made in 1939 to obtain additional information on these points.

One hundred and forty-two fruiting laterals of Rubel were measured whose diameters varied from 1/32 to 9/32 inch. These laterals were also measured for length, and a count was made of the number of fruit buds and blossoms present. Later the berries from each lateral were harvested, counted and weighed. The data were then summarized for laterals of the same diameter (Table 5). It is apparent from these data that there was a direct correlation between the size of lateral and total yield, and to a slightly variable but nonetheless significant degree with reference to size of berry at least up to and including laterals 7/32 inch in diameter. This accounts for the higher percentage of the crop maturing earlier on the heavier pruned plants since the heavier pruning encouraged the growth of larger fruiting laterals.

Experiments were also conducted in 1939 involving the removal

TABLE 5.—Average number of fruit buds, blossoms and fruits harvested; percentage fruit set; yield; weight per berry and grade of laterals 1/32 to 9/32 inch in diameter

No. of laterals used	Diameter (inches)	Length (inches)	No. fruit buds	No. blossoms	No. fruits harvested	Percent fruit set	Average yield per lateral in oz.	Average weight per berry in oz.	Grade
12	1/32	1.50	2.0	11.0	7.6	69.1	.196	.0256	Lake State
20	2/32	3.34	3.6	23.6	15.9	67.4	.378	.0247	Lake State
20	3/32	5.95	4.7	37.8	28.0	74.1	.758	.0272	Columbia
18	4/32	7.55	5.0	41.1	30.0	73.1	.860	.0281	Columbia
16	5/32	11.68	6.4	58.3	37.8	63.8	1.051	.0278	Columbia
18	6/32	16.54	7.9	75.7	50.2	66.3	1.514	.0301	Columbia
17	7/32	19.34	7.1	59.2	46.9	79.1	1.534	.0336	Columbia
10	8/32	23.98	8.8	81.7	66.9	80.6	2.089	.0312	Columbia
11	9/32	27.26	11.9	108.7	85.9	79.0	2.537	.0308	Columbia



Fig. 10. Fruiting laterals of Rubus ranging in diameter from 1/32 to 9/32 inch, left to right (first three in upper left corner).

of a certain number of blossoms, leaves, and fruits from laterals and stems of equal diameter. The results of these experiments are not given in detail, but it can be stated that the removal of blossoms and fruits resulted in a reduction in yield in all instances, with very slight increase in size of berry. The results of the foliage removal experi-

TABLE 6—Diameter of berries and average weight—Rubus variety

Diameter of berry (inches)	Total number of berries	Total weight of berries (ounces)	Berries per grading cup	Average weight per berry (ounces)	Grade
11/32	6	.06	.....	.0100	Lake State
12/32	299	4.94	297	.0165	Lake State
13/32	291	5.50	247	.0189	Lake State
14/32	242	5.56	204	.0229	Lake State
15/32	169	4.87	165	.0288	Columbia
16/32	205	7.19	137	.0350	Golden Moon
17/32	154	6.00	118	.0389	Golden Moon
18/32	122	5.69	105	.0466	Golden Moon
19/32	54	2.87	94	.0531	Golden Moon
20/32	8	.50	.....	.0625	.....

ments were somewhat variable, but it is apparent in the case of blueberries, as with peaches, plums and a number of other fruits, that the development of fruit on certain clusters does not depend exclusively on the foliage on the shoots bearing these clusters. The fruit evidently draws on the foliage from some little distance away, which probably was responsible for the lack of consistency in the responses obtained.

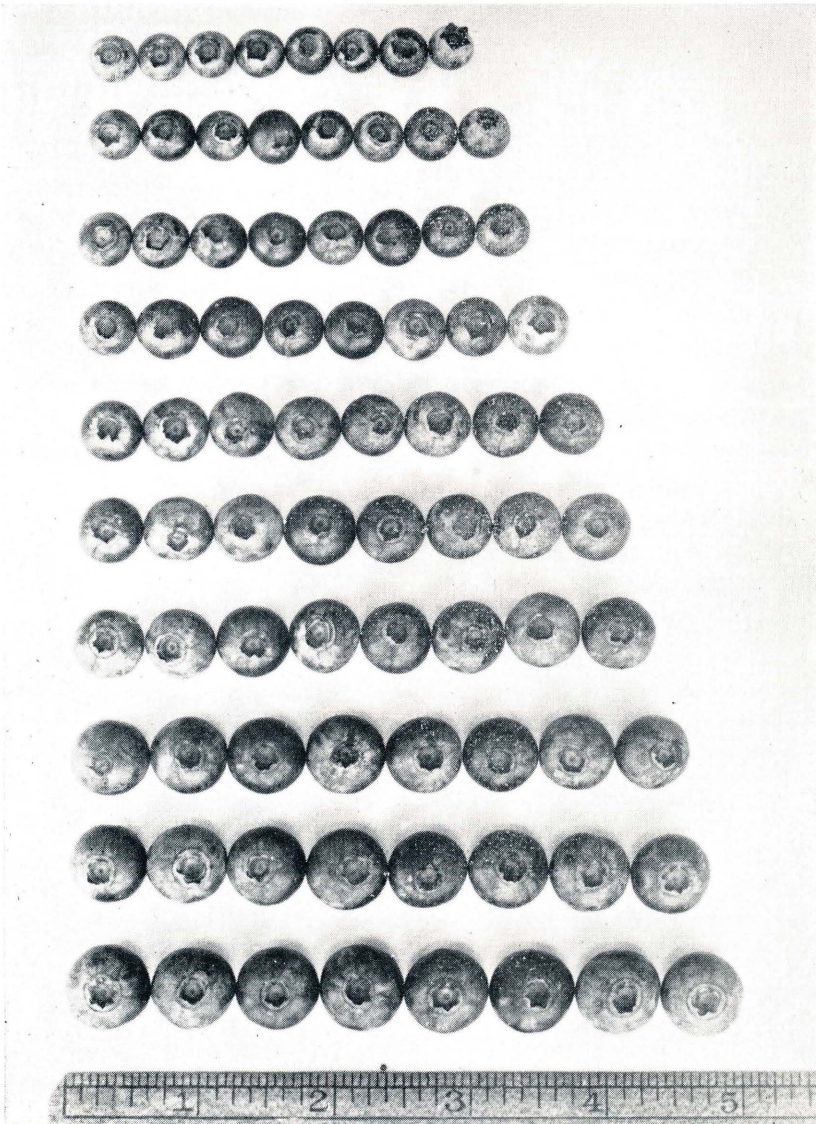


Fig. 11. Top to bottom: Rubel berries of various sizes ranging from $11/32$ to $20/32$ inch. Comparative weights for these berry sizes are shown in Table 6.

In order to show the comparative weights and sizes of blueberries, a large number of berries were calipered for diameter and weighed. See Fig. 11 and Table 6 for these comparisons.

SUMMARY OF RESULTS

1. Plants used in this experiment were growing on a better-than-average Saugatuck sandy loam soil; they had received an intermediate pruning each year before the experiment was initiated, and the rainfall was above normal for the months of June, July, and August three of the four years of the experiment. These conditions were favorable for the production of large crops on plants which possessed a large bearing capacity.
2. Unpruned plants averaged larger yields for the four-year period than pruned plants. The average yield decreased as the severity of pruning increased.
3. The average size of berries of both varieties increased as severity of pruning increased.
4. The size of berries increased as diameter of the laterals increased from $1/32$ to $7/32$ inch. The size of berries decreased, but total yield continued to increase on laterals as large as $9/32$ inch in diameter.
5. Pruned plants matured a larger percentage of their crop the first three pickings than did unpruned plants. The more severe the pruning, the larger the percentage of the crop which matured early in the season.
6. Berries matured earlier on large laterals than on small laterals.
7. Unpruned plants earned greater gross return than plants which received an annual pruning, and the returns decreased with increased severity of pruning.

DISCUSSION

The results of these experiments in pruning the highbush blueberry might be summarized by stating that the more severe the pruning given a mature highbush blueberry plant the greater the reduction in yield, the larger the berries produced, and the earlier the maturity of the berries.

Total yield, size of individual fruits, and time of maturity are all important factors in determining the financial return received by the grower. The relative importance of these factors must be weighed by each grower in deciding on the amount of pruning to give his plants. If early berries are particularly valuable, pruning should be more severe than if the greatest possible total yield is desired. Should the largest berries be needed to meet certain market demands and a suf-

ficiently higher price be obtained for them to compensate for the reduced yield, then again a fairly severe type of pruning would be needed. When late berries bring a higher price, even though of only medium size, then the pruning should be as light as possible to maintain reasonably good growth and the production of berries of moderate size.

Michigan blueberry growers usually receive their best prices for late berries, the earlier maturing ones meeting with too heavy competition from wild blueberries that mature somewhat earlier than those that are cultivated, from cultivated blueberries from other states, and from strawberries, raspberries and cherries.

On the basis of these experiments it might be thought that Michigan blueberry growers would lose money by doing any pruning. However, consideration must be given to several factors before coming to this conclusion. *First*, the plants used in this experiment were growing on soil somewhat above average in productiveness. *Second*, three of the four years of the experiment were above average in rainfall. *Third*, the plants were 10 years old when the experiment started and had received a moderate pruning annually. No doubt the residual effect of the previous pruning in encouraging new growth extended somewhat into the time covered by the experiment. *Fourth*, there was evidence in 1941, the one year of the test when rainfall was below normal, that

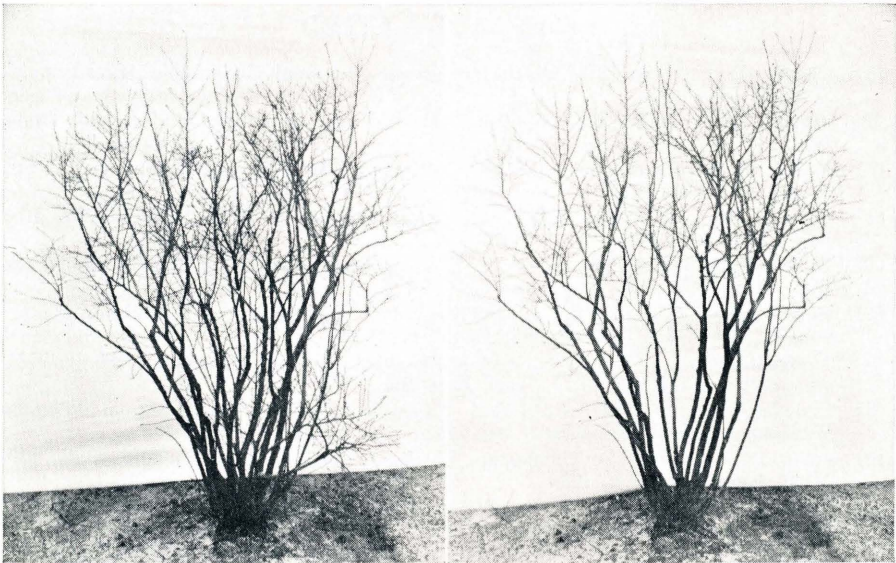


Fig. 12. Left: A mature Rubel bush before pruning. Right: The same bush after receiving the light type of pruning recommended for the average Michigan plantation. Lower branches and one old stem have been removed, together with a few of the larger clusters of fine, bushy wood. Plants growing on light soils poorly supplied with organic matter will probably have to be given somewhat heavier pruning than shown above.

the unpruned plants were carrying too large a crop of fruit to be matured properly. Some berries were so small and dry as to be unmarketable.

For these reasons a light type of pruning, rather than no pruning, is recommended for highbush blueberry plants growing under average conditions in Michigan. Only the oldest stems, or parts of stems, that are producing nothing but thin, weak, bushy wood should be removed. Plants growing on light soils deficient in organic matter probably should be pruned somewhat more severely than those on more fertile soils because of the inability of the lighter soils to furnish sufficient moisture to mature the large crops produced on unpruned or lightly pruned plants. The light type of pruning recommended for mature plants in the average Michigan blueberry plantation is shown in Fig. 12.

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