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VARIETIES AND LOCATIONS AS FACTORS IN APPLE PRODUCTION

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MICHIGAN STATE COLLEGE
Of Agriculture and Applied Science

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VARIETIES AND LOCATIONS AS FACTORS IN APPLE PRODUCTION

By V. R. GARDNER

The most casual acquaintance with the variety lists of apples which constitute the commercial plantings in Michigan, or a single visit to one of the large packing houses in the height of the packing season is enough to convince anyone of the need of reducing the number of varieties that are grown and of standardizing on a few sorts that can be grown and marketed most profitably. However, when it comes to deciding between those which should be discarded and those which should be retained, differences of opinion arise at once.

Much good has been accomplished during recent years by the publicity given to the variety list recommended by the Michigan State Horticultural Society. Though this list was not based on exact figures on yields or prices, it reflected the experience and judgment of many of the leaders in the industry. Certainly, it has had the effect of reducing the number of varieties that have been set in newer commercial plantings and in keeping out of these plantings many varieties that would be sure to prove liabilities rather than assets. Considerable grafting over of miscellaneous sorts to these few varieties which are named on the State Horticultural Society list has also been done.

The millennium is not at hand, however, and neither these recommendations nor any others will be universally followed. Someone is sure to rise to the defense of every variety that may be suggested for elimination, and, without doubt, good things may be said of practically every variety that has been introduced. Nevertheless, certain varieties are admittedly better than others from a commercial standpoint. Some few must be best, at least for average Michigan conditions.

THE PROBLEM STATED

The purpose of the investigation, which this bulletin reports, has been to make a rather careful analysis of the apple variety problem in Michigan, in the hope that definite, specific answers could be obtained to the following questions: (1) What varieties do the commercial orchards of bearing age actually contain and what are the relative numbers of these varieties of different ages? (2) What varieties are now being set in commercial plantings and in what relative numbers? (3) What average prices are being obtained for fruit of different grades of these varieties? (4) How does the

fruit of these different varieties, as ordinarily grown in the commercial orchards of the state, grade out? (5) How do trees of different ages of these different varieties yield? (6) Finally, what are the average returns per tree and per acre for each of the more common varieties of different ages?

Answers to these questions should make possible fairly definite varietal recommendations for future plantings and furnish present growers with a body of information on which an intelligent decision can be made as to the wisdom of retaining, grafting over or destroying trees of certain other kinds. It was not expected that the data would warrant varietal recommendations materially different from those recently made by the Michigan State Horticultural Society. It was believed, however, that the evidence obtained would give such recommendations greater weight and lead to more rapid standardization of the commercial variety list.

It is realized that the variety problem is somewhat different for the individual who does more or less of a retail business; who sells directly to the consumer, or to hucksters, or "truckers"; or who sells on a municipal market, or who caters to a summer tourist trade than it is for the producer who ships in carlots to wholesale distributors. The problem of the man whose product is retailed is at one and the same time more simple and more complicated. His trade is less exacting; he can "get by" with less standardization of product than the carlot producer. It may occasionally be to his advantage to have for sale small lots of some of the less common sorts. On the other hand, there is reason to believe that in the majority of cases even those who have the more special markets would profit not only by greater standardization of product but also by standardization on the very varieties that the carlot grower finds most profitable. Certainly, if he raises only those varieties, he has the option between the more general carlot and the more special smaller-unit markets, an option that at any time may be worth a great deal. This investigation deals primarily with the variety problem of the shipper.

PROCEDURE

Information as to the numbers and ages of bearing trees of different varieties was obtained by visiting the orchards of 100 representative fruit growers in the so-called "Fruit Belt" between the Michigan-Indiana line and Traverse City. The orchards selected included young and old, large and small, and included some of the best and some of the poorest commercial plantations. They may be considered to constitute a fair cross section of Michigan's apple industry. The owners themselves furnished information as to age and number of trees. Notes were taken on location, site, soil, vigor and type of growth and on openness or density of tree as affected by pruning. Management methods were discussed with the owners and records made of cultural, fertilizer, spraying, pruning and other practices that had been employed during the recent years. Generally, total yield records were obtained from the books of the co-operative organizations through which the fruit had been sold; these records were supplemented by figures given by the growers in those cases where a portion of the crop had been sold inde-

pendently. Average yields were calculated from the total yield records and number of trees; this was possible only in those cases where the entire crop of a given variety had been harvested from trees of uniform age. Data on the way that the fruit of the many varieties from various orchards graded out, and on the prices for which the several grades of those varieties sold each year for the 1921-1925 period were obtained from the books of the selling organizations. These records are for the entire turnover of the organizations for this period, not simply what they handled for the 100 commercial growers from whom orchard data were obtained. The total volume of this business was a little over a million bushels. Many records were obtained of private sales effected by individual growers, but the averages given in the following tables are those for the co-operative fruit exchanges located at Coloma, Hartford, Bangor, South Haven, Fennville, Saugatuck, Shelby, and Beulah.

THE VARIETIES FOUND IN MICHIGAN ORCHARDS

In Table 1 are presented data showing the numbers and percentages of trees of different varieties and ages in the 100 commercial orchards included in the study. Table 2 shows the varietal composition of a random sample of non-bearing commercial orchards in Michigan. This table, however, includes orchards in the central and eastern as well as the western parts of the state. The figures are therefore even more representative than those in Table 1.

Table 1 lists a total of 130 varieties of bearing age found in the 100 orchards. In many cases, there were only a few trees of a variety. This was true particularly of some of those limited to the older plantings, obviously the survivors of a generation when market demands and commercial standards were not so well established as now and when in a sense each orchard was a kind of a variety test plot. Nevertheless, the trees are there; the fruit is being harvested and delivered to the central packing houses where it must be kept separate from that of other varieties. It then must be sold under its own label to someone who probably knows little or nothing about it and who takes it under protest along with some other sort or sorts that he really wants. Only 20 of these 130 varieties found in the bearing orchards individually constitute more than one per cent of the total tree population. The remaining 110 together occupy less than 11 per cent of the total bearing acreage and the 80 that are found in smallest numbers together make up only two per cent of the orchard population. In other words 61 per cent of the varieties now present in the commercial orchards are found in negligible numbers and another 23 per cent furnish only a small percentage of the total output.

It is interesting that the total number of varieties in the older plantings (those over 35 years) is 110, the total number in the 21-35-year-old plantings is 46, and the total number in the bearing orchards under 20 years old is 55. In the orchards over 35 years of age, 22 varieties constitute 90 per cent of the tree population; 13 varieties make up 90 per cent of the 21-35-year-old trees; 16 varieties make up 90 per cent of the 11-20 year old trees; 12 varieties make up 90 per cent of the trees under 11 years of age. There is

Table 1.—The varietal composition of 100 commercial apple orchards of bearing age in Michigan.

Variety	Total No. trees bearing age	Percent of total	No. bearing trees under 10 yrs.	Percent of total trees of that age	No. trees 11-20 yrs.	Percent of total trees of that age	No. trees 21-35 yrs.	Percent of total trees of that age	No. trees over 35 yrs.	Percent of total trees of that age
Duchess	11542	20	1720	12	6813	30	1742	24	1267	9
Jonathan	5770	10	3594	25	1704	8	420	6	52	32
Baldwin	5733	10	424	3	352	2	461	6	4496	5
Wagener	5145	9	3195	22	1058	5	93	1	799	5
Wealthy	3303	6	796	6	1715	8	764	11	28	6
Northern Spy	3029	5	363	3	1392	6	418	6	856	6
Stark	2507	4	435	3	897	4	447	6	728	5
R. I. Greening	2071	4	300	2	31	*	503	7	1240	9
Grimes	1856	3	650	5	1040	5	88	1	78	*
Hubbardston	1724	3	430	3	613	3	551	8	130	*
Y. Transparent	1588	3	204	1	1127	5	221	3	36	*
Delicious	1205	2	122	1	1082	5	*	*	*	*
King	1185	2	200	1	334	2	151	2	500	4
McIntosh	917	2	125	*	791	4	*	*	*	*
Snow	914	2	730	5	59	*	21	*	104	*
Winter Banana	859	2	428	3	101	*	315	4	15	*
Ben Davis	834	1	*	*	53	*	92	1	689	5
Wolf River	717	1	*	*	284	1	425	6	8	*
Canada Red	633	1	105	*	260	1	57	*	217	2
Gideon	593	1	5	*	539	2	40	*	9	*
Livland Raspberry	457	*	*	*	457	2	*	*	*	*
Chemango	366	*	*	*	149	*	*	*	217	2
Golden Russet	351	*	*	*	*	*	*	*	351	3
Winesap	336	*	21	*	312	1	*	*	*	*
Maiden Blush	335	*	33	*	75	1	6	*	220	2
Northwest Greening	321	*	247	2	70	*	4	*	*	*
Opalescent	262	*	*	*	230	1	32	*	*	*
Westfield (Seek-No-Further)	244	*	207	1	*	*	*	*	37	*
Tolman Sweet	231	*	*	*	34	*	54	*	143	1
Sutton	209	*	*	*	125	*	9	1	3	*
Red Astrachan	163	*	15	*	17	*	9	*	122	*
Fall Pippin	163	*	*	*	*	*	4	*	159	1
King David	154	*	120	*	30	*	4	*	*	*
Roxbury Russet	119	*	*	*	2	*	*	*	117	*
Cobasha	114	*	*	*	*	*	10	*	104	*
Covert	102	*	*	*	*	*	14	*	88	*
Spitzenburg	96	*	*	*	*	*	*	*	96	*
Sweet Bough	94	*	5	*	14	*	25	*	50	*
Shiawassee	92	*	*	*	90	*	*	*	2	*
Rambo	81	*	*	*	*	*	*	*	81	*
Vandevere	81	*	*	*	50	*	*	*	31	*
Twenty Ounce	75	*	*	*	32	*	2	*	41	*
Benoni	69	*	*	*	65	*	*	*	4	*
Rubicon	69	*	*	*	54	*	*	*	69	*
Pound Sweet	68	*	*	*	54	*	6	*	8	*
Alexander	68	*	1	*	44	*	25	*	18	*
York Imperial	66	*	20	*	14	*	*	*	32	*
Fallawater	62	*	*	*	15	*	12	*	35	*
Boiken	60	*	*	*	60	*	*	*	*	*
Collins	50	*	*	*	50	*	*	*	*	*
Early Harvest	50	*	*	*	*	*	6	*	44	*
Pewaukee	48	*	*	*	5	*	6	*	37	*
Walbridge	48	*	*	*	*	*	48	*	*	*
McMahon	40	*	*	*	40	18	*	*	*	*
Yellow Bellflower	39	*	*	*	*	*	*	*	39	*
Mann	35	*	3	*	12	*	*	*	20	*
Phoenix	34	*	*	*	*	*	1	*	33	*
Mammoth Black Twig	33	*	*	*	20	*	*	*	13	*
Bismarck	30	*	*	*	30	13	*	*	*	*
Primate	29	*	*	*	*	*	*	*	29	*
Lowell	28	*	*	*	2	*	2	*	24	*
Golden Sweet	28	*	4	*	*	*	*	*	24	*
Gravenstein	28	*	*	*	2	*	20	*	6	*
St. Lawrence	27	*	*	*	*	*	*	*	27	*
Rome	26	*	*	*	25	.11	*	*	1	*
Strawberry Pippin	25	*	*	*	*	*	*	*	25	*
Swaar	24	*	*	*	*	*	*	*	24	*
Gano	22	*	*	*	22	*	*	*	*	*
Ribston Pippin	22	*	*	*	*	*	*	*	22	*
Black Gilliflower	21	*	*	*	*	*	*	*	21	*
Runkleford	20	*	*	*	*	*	*	*	20	*
Red Streak	17	*	*	*	3	*	*	*	14	*

*Less than one per cent of the total number of trees of that age.

Table 1.—Continued

Variety	Total No. trees bearing age	Percent of total	No. bearing trees under 10 yrs.	Percent of total trees of that age	No. trees 11-20 yrs.	Percent of total trees of that age	No. trees 21-35 yrs.	Percent of total trees of that age	No. trees over 35 yrs.	Percent of total trees of that age
Jefferis.....	16	*	1	*			9	*	6	*
Cranberry Pippin.....	15	*					1	*	14	*
Petoskey.....	15	*							15	*
Neverfail.....	14	*							14	*
Green Sweet.....	14	*							14	*
Holland Pippin.....	14	*							14	*
Fall Jenneating.....	13	*							13	*
Pearmain.....	12	*							12	*
York Stripe.....	12	*							12	*
Sweet Pippin.....	11	*			5	*			6	*
Belmont.....	11	*							11	*
English Russet.....	10	*							10	*
Honey Sweet.....	10	*			2	*			8	*
Ralls (Geniton).....	9	*							9	*
Sweet Russet.....	9	*							9	*
Peck Pleasant.....	9	*							9	*
Porter.....	9	*							9	*
Jersey Sweet.....	9	*							9	*
Short Stemmed Pippin.....	8	*							8	*
Rosseau.....	8	*							8	*
Gray.....	7	*							7	*
Golden Pippin.....	7	*							7	*
Ingram.....	7	*			7	*				*
Lady Washington.....	7	*			2	*			5	*
Nonpareil.....	6	*					1	*	5	*
Pennock.....	6	*					3	*	3	*
Perry Russet.....	6	*							6	*
Indian.....	6	*			6	*				*
Arkansas Black.....	6	*			6	*				*
Virginia Red.....	5	*							5	*
Ash.....	5	*							5	*
Spice.....	5	*							5	*
Beitigheimer.....	4	*			4	*				*
Minister.....	4	*							4	*
Willow Twig.....	4	*							4	*
Stayman Winesap.....	4	*					4	*		*
Red Stripe.....	4	*							4	*
Roek Pippin.....	4	*							4	*
Fall King.....	3	*							3	*
Blenheim Pippin.....	3	*							3	*
Anjou.....	2	*							2	*
Martin.....	2	*							2	*
Chicago.....	2	*							2	*
Cooper Market.....	2	*							2	*
Detroit Red.....	2	*							2	*
Doctor.....	2	*							2	*
Domine.....	2	*							2	*
Western Spy.....	2	*							2	*
Stone Pippin.....	2	*							2	*
Ridge Pippin.....	2	*							2	*
Red June.....	1	*							1	*
Pumpkin Sweet.....	1	*							1	*
Garfield.....	1	*							1	*
Lady Sweet.....	1	*							1	*
Baker.....	1	*							1	*
Brown.....	1	*							1	*
Bailey Sweet.....	1	*							1	*
Total.....	58,143	.....	14,503	.....	22,428	.....	7,200	.....	14,012	.....

*Less than one per cent of the total number of trees of that age.

clear evidence of a tendency to narrow the variety lists for the commercial orchards. This, however, is checked rather effectively by the constant planting of newly introduced sorts.

The great diversity in the variety lists of the commercial orchards of the state as a whole is naturally reflected in the varietal composition of individual orchards. The average number of varieties in the 100 orchards

which were studied was exactly 25. One orchard contained bearing trees of 65 varieties.

The number of trees of certain kinds and the volume of fruit which they produce was so small that the price, grading, and yield data were not considered sufficient to warrant including in this publication. The varieties that are included in this list are: Anjou, Baird, Baker, Bailey Sweet, Baltimore Greening, Ben Hur, Doctor, English Russet, Garfield, Golden Pippin, Green Sweet, Holland Pippin, Honey Sweet, Jefferis, Jersey Sweet, Lady Sweet, Ingram, Indian, McMahan, Martin, Nonpareil, Neverfail, Pumpkin Sweet, Pearmain, Ridge Pippin, Pennock, Porter, Perry Russet, Red Stripe, Rosseau, Short-stemmed Pippin, Tallow Pippin, Stone Pippin, Virginia Red, Walbridge, Willow Twig, and York Stripe. Most of these 42 varieties are found only in the older orchards. It may be stated in regard to each of them that the limited records available furnish no recommendation

Table 2.—The varietal composition of representative non-bearing commercial apple orchards in both eastern and western Michigan.

Variety	Total No. trees	Percent of total
Jonathan	10,069	17
McIntosh	8,158	14
Northern Spy	5,689	10
Delicious	5,522	9
Grimes	4,414	7
Wagener	4,057	7
Wealthy	2,914	5
Canada Red	2,686	5
Duchess	2,070	3
Snow	1,947	3
Rhode Island Greening	1,860	3
Hubbardston	1,737	3
Baldwin	1,521	3
Stayman Winesap	1,299	2
Golden Delicious	880	1
Yellow Transparent	660	1
Stark	555	*
King David	535	*
Gano	533	*
Winesap	491	*
Ontario	450	*
Winter Banana	407	*
Maiden Blush	307	*
Shiawassee	200	*
Wine	100	*
Cortland	100	*
Wolf River	98	*
Chenango	83	*
King	75	*
Mammoth Black Twig	65	*
Gideon	53	*
Livland Raspberry	50	*
Yellow Bellflower	40	*
Golden Sweet	35	*
Rome	23	*
Northwest Greening	25	*
Opalescent	20	*
Twenty Ounce	15	*
Salome	15	*
Red Astrachan	15	*
Sweet Bough	10	*
Alexander	10	*
Ben Davis	10	*
Total	59,803	100

*Less than one percent.

for their further planting. Indeed they indicate the probable wisdom either of destroying the trees or of grafting them over to more profitable sorts.

The figures in Table 2, which give the varietal composition of the commercial plantings that have not yet reached bearing age, furnish still further evidence of the tendency to plant fewer varieties for only 43 names appear in this list and 14 varieties constitute 90 per cent of the new plantings. However, this list includes three new varieties, the Golden Delicious, Cortland, and Wine and several varieties that are found only in small numbers in the bearing orchards occupy a place of somewhat greater prominence. These are: Gano, King David, Ontario, Stayman Winesap, and Winesap.

Jonathan, McIntosh, Northern Spy, and Delicious head the list in the newer plantings and occupy relatively much more dominant positions than in the older orchards. Canada Red, Grimes, and Snow likewise promise to occupy somewhat more prominent places in future production, and Baldwin, Rhode Island Greening, and Hubbardston, after a period of waning popularity, are apparently gaining in favor, slowly, perhaps, but certainly. On the other hand, planting of the Duchess, Stark, Wagener, and Wealthy is gradually decreasing, that of the Duchess very rapidly. This change in the relative popularity or importance of the more prominent kinds is brought out by the figures presented in Table 3.

Unfortunately, however, extensive planting of a variety does not always mean that it has been, that it is, or that it will be the most profitable. In the long run, certain kinds prove so unsatisfactory, because of low yield, poor grading out of the product, or low price that they are discarded. This is the explanation of the constant disappearance of varieties. Not all of those that remain, however, are equally profitable. Some should be eliminated. Only a few should be retained. The question is, "Which"?

Table 3.—Changes in relative popularity and importance of some of the more prominent apple varieties. Figures show the percentages of the total numbers of trees of each variety that are of different ages.

Variety	Total No. of bearing and non-bearing trees	Percent-age over 35 yrs. old	Percent-age 21-35 yrs. old	Percent-age 11-20 yrs. old	Percent-age under 11 yrs. old
Jonathan.....	15,839	*	3	11	86
Duchess.....	13,512	9	13	50	28
McIntosh.....	9,992	*	8	1	91
Wagener.....	9,202	9	1	11	79
Northern Spy.....	8,718	10	5	16	69
Baldwin.....	7,254	62	6	5	27
Delicious.....	6,726	.....	.....	16	84
Grimes.....	6,270	1	1	17	81
Wealthy.....	6,117	*	12	28	60
Rhode Island Greening.....	3,934	32	13	1	54
Hubbardston.....	3,461	4	16	18	62
Stark.....	3,062	24	15	29	32
Canada Red.....	3,325	7	2	8	83
Snow.....	2,861	4	1	2	93
Yellow Transparent.....	2,248	1	10	50	39
Stayman Winesap.....	1,299	.....	.....	.....	100
Winter Banana.....	1,266	1	25	8	66
King.....	1,185	42	13	30	15
Golden Delicious.....	880	.....	.....	.....	100
Ben Davis.....	844	82	11	6	1
Wolf River.....	717	1	59	40	.....
Maiden Blush.....	652	34	1	11	54
Gano.....	535	.....	.....	.....	100

*Less than one per cent.

THE MARKET VALUE OF DIFFERENT APPLE VARIETIES

One of the first questions that a producer asks about a variety is the price for which it will sell. Certainly, this is important in determining its relative value for commercial culture. Most growers have a general opinion as to the market value of at least the more important varieties which they are raising, but only a few growers can give reliable figures on average prices for different grades over a term of years, and these figures alone furnish a reliable index for a comparison of the value of varieties.

The data in the accompanying table (Table 4) should be understood as furnishing only approximately average prices. For instance, if all the crop of some relatively unimportant variety was sold "tree-run" or "bulk" in a low-price year, thus preventing the averaging of an A-grade price for that season, the 5-year A-grade average would be somewhat higher than it should in relation to other varieties. If year after year a large portion of the crop of certain inferior varieties is sold in bulk, while only the lower grades of certain other varieties are sold in that way, the bulk price of the inferior varieties appears unduly high. Another factor, the influence of "bracketed sales," has served to lessen the true difference in value of the different varieties.

When the buyer is practically forced by the sales manager to take a quarter or a third of a carload of undesirable varieties with each carlot of the kind or kinds which he wants, he naturally pays less than he otherwise would for the good sorts, and the poor ones are credited with bringing a price materially higher than they would if sold alone on their own merits. There is no way of determining accurately the amount of this influence but there is reason to believe that it is considerable. It is probable that except for this influence of "bracketed sales," the figures as given represent the average for enough seasons and for enough shippers to be fairly representative and indicate about what the relative value per bushel or per hundredweight of different grades and of different varieties will be for some years to come. Average prices are given for the five-year period (1921-1925) for the A- and B-grade and for cider, canners', unclassified, and bulk stock. It will be recalled that 1921 was a year of exceptionally high prices; 1922 and 1923 were years of low prices; 1924 and 1925 prices were more nearly average. On the whole, this five-year period may be considered fairly representative of the general price level for apples. The A-grade averages for the two low-price years, 1922-1923, are included.

As indicated in the table heading, the figures are f.o.b. shipping point prices. In the cases of the A-, B-, and unclassified grades, the grower was paid these prices, less the packing, package and selling charges. The packing and package charges have averaged \$0.32 per bushel for packed fruit during the five-year period in question. The selling commission charged by the Associations has amounted to five per cent of the selling price. Thus a bushel of A-grade Hubbardston, selling for \$1.15 actually brought the grower 77 cents and a bushel of A-grade McIntosh selling for \$1.50 per bushel brought him \$1.10. Only that fruit sold for \$1.39 or better has brought the grower a net price of \$1.00 per bushel.

Table 4.—Average market value (f. o. b. shipping point) of different grades and of different varieties.

Variety	1922-23 A-grade average per bu.	Averages for the 1921-1925 seasons					
		A-grade per bu.	B-grade per bu.	C-grade per cwt.	Canner per cwt.	Unclassi- fied per bu.	Bulk per cwt.
Arkansas Black	\$0 66	\$1 00	\$0 84	\$0 50	\$1 00		
Lowell	91	1 04	79	52	96	67	\$1 80
Ralls (Geniton)	76	1 05	85	53	1 02		1 35
Early Harvest	82	1 07	78	55	1 14	89	1 36
Ben Davis	87	1 10	86	54	1 08	93	1 58
Primeval	74	1 11	74	54	1 19	75	
Lady Washington	78	1 11	82	43			
Beitigheimer	80	1 12	62	53	1 01		
Domine		1 12	85	62	1 06		1 35
Gideon	87	1 12	84	56	1 08		1 56
Rambo	89	1 12	82	56	1 15	72	1 40
Runkleford		1 12	80	55		70	
Pound Sweet	88	1 12	84	56	1 11	61	1 10
St. Lawrence	83	1 13	82	60	95	75	
Gano	68	1 13	80	64			
Fallwater	83	1 14	78	52	1 04	63	1 33
Cabashea	82	1 15	89	59	1 32	67	1 36
Phoenix	87	1 15	92	56	1 19	67	1 75
Hubbardston	95	1 15	98	57	1 10	79	1 42
Mammoth Black Twig	96	1 16	77	56	97	75	
Blenheim Pippin	87	1 16	79	56		67	
Pewaukee	80	1 16	86	55	1 24	80	1 45
Fall Pippin	78	1 18	78	55	1 13	65	1 44
Ribston Pippin	87	1 18	86	55	1 05	67	
Yellow Bellflower	85	1 18	93	54	1 12	87	1 49
Colvert	82	1 20	86	60	1 11	66	1 60
York Imperial	94	1 20	94	55	1 11	94	1 19
Westfield (Seek-no-further)	94	1 21	88	57	1 16	85	1 44
Red Astrachan	87	1 22	81	54	1 25		1 81
Wolf River	89	1 22	87	59	1 12	95	1 50
Black Gilliflower	99	1 22	91	57	1 14	75	1 38
Cooper Market		1 23	91	58	1 11	70	1 45
Boiken	93	1 23	98	58	1 18	63	1 33
Gravenstein	1 02	1 25	92	60	1 04	67	
Twenty Ounce	99	1 25	96	51	1 02	86	1 65
Roxbury Russet	99	1 26	89	57	1 20	83	1 04
Cranberry Pippin	96	1 26	94	50		67	1 60
Alexander	1 00	1 27	93	52	1 41		
Belmont		1 27	96	58			
Wagner		1 27	96	51	1 14	76	1 40
Swaar	98	1 28	93	55	1 14	89	1 41
Maiden Blush	93	1 28	86	51	1 12	67	1 56
King David	1 08	1 29	92	55	1 41		1 39
Ontario	97	1 29	95	56	1 07	92	1 54
Rome	87	1 29	97	53	1 16	95	1 81
Bismarck	1 00	1 30	89	56		67	
Vandevere	1 06	1 30	1 02	60	97		
Duchess	83	1 31	89	51	1 04	67	1 75
Winter Banana	94	1 34	94	61	1 13	84	1 89
Northwestern Greening	94	1 34	99	62	1 05	93	1 55
Mann	95	1 35	93	58	1 12	87	1 08
Chenango	93	1 35	92	58	1 11	84	1 35
Shiawassee	96	1 35	98	56	1 23	70	
Stark	1 00	1 35	1 00	55	1 13	77	1 37
Sutton	1 03	1 36	78	59	1 10	67	1 15
Tolman Sweet	1 01	1 36	97	54	1 13	92	1 42
Winesap	1 16	1 36	95	59	1 17	87	1 80
Wealthy	1 05	1 37	1 03	56	95	82	1 30
Grimes	1 00	1 38	1 08	54	1 05	85	1 52
Opalescent	1 08	1 39	96	55	1 02	80	1 65
Rubicon	1 14	1 40	1 15	53			1 81
Benoni	85	1 41	95	60			
Spitzenburg	1 12	1 44	1 11	58	1 17		1 25
Golden Russet	1 11	1 45	1 08	57	1 18	70	1 27
Rhode Island Greening	1 19	1 46	1 08	58	1 09	79	1 78
Baldwin	1 13	1 48	1 07	60	1 01	91	1 70
Snow	1 16	1 48	1 10	56	1 06	77	1 41
King	1 15	1 48	1 07	56	1 15	75	1 27
Golden Sweet	1 23	1 49	1 02	55	1 07	68	
McIntosh	1 05	1 50	97	58	1 04	70	1 81
Canada Red	1 19	1 50	1 13	55	97	66	1 63

Table 4.—Continued

Variety	1922-23 A-grade average per bu.	Averages for the 1921-1925 seasons					Bulk per cwt.
		A-grade per bu.	B-grade per bu.	C-grade per cwt.	Canner per cwt.	Unclassi- fied per bu.	
Northern Spy.....	\$1 19	\$1 51	\$1 08	\$ 60	\$1 08	\$ 94	\$1 83
Jonathan.....	1 32	1 62	1 23	52	1 06	79	1 94
Sweet Bough.....	1 17	1 64	1 03	58	1 19	87	1 51
Yellow Transparent.....	1 25	1 77	1 12	56	1 16	1 02	1 41
Delicious.....	1 43	1 91	1 27	53	1 06	.....	1 89
Ave. for all varieties.....		\$1 29	\$0 93	\$0 56	\$1 11	\$0 78	\$1 50
For lowest 25 varieties.....		1 12	82	55	1 09	73	1 45
For middle 26 varieties.....		1 27	93	56	1 14	79	1 49
For top 25 varieties.....		1 47	1 05	57	1 09	80	1 55
Ave. net per bu. to growers for all varieties.....		90	56	17	40	42	56
For lowest 25 varieties.....		74	46	16	38	37	51
For middle 26 varieties.....		88	56	17	43	43	55
For top 25 varieties.....		1 07	68	18	38	44	61

The A-grade fruit of 17 varieties has measured up to this standard over the five-year period covered by this study. For the unpacked fruit that the exchanges have sold to canneries, cider mills, and for that which was sold in bulk, there has been an average handling charge of 15 cents per hundred-weight, plus the usual five per cent selling commission on price received. Thus cider grade fruit selling for 55 cents has brought the grower approximately 37 cents per hundred pounds or a trifle less than 18 cents per bushel; canners' stock selling for \$1.10 per hundredweight has brought him about 43 cents per bushel, and bulk stock selling for \$1.50 per hundredweight has brought him about 60 cents per bushel. These are in a sense net prices—prices for the fruit itself delivered on the receiving platform of the central packing house.

The average prices received for the different grades of all varieties are interesting. With packing house and selling charges deducted from the figures given in the table, the five-year average return per bushel to the grower for A-grade apples of all varieties was approximately 90 cents, for B-grade 56 cents, for cider stock 17 cents, for cannery stock 40 cents, for unclassified stock 42 cents and for bulk 56 cents. Though B-grade fruit has sold at a higher price than bulk stock it has netted the producer no more, because of package and packing costs. Unclassified or "tree-run" fruit has brought him less.

On the average, it has been more profitable for the grower to have his fruit "bulked out," to the extent that there was a market for this grade, than sold to the canners. If all varieties are considered together, the only fruit that has brought the grower greater returns than the bulk product has been the A-grade. The advantage in producing a high percentage of this grade becomes apparent, as it is doubtful if the average price for the lower grades yields much net profit after production costs are deducted.

The average difference in price per bushel between the A- and B-grades for all varieties is 36 cents; in the case of the 25 lowest-priced varieties it is 30 cents; for the 25 highest-priced varieties it is 42 cents. Evidently, the better the variety, the greater is the premium that the market is willing to pay for the high grade product. As would be expected, the cider and

canner grades of the good varieties sell at only slightly higher prices than corresponding grades of the poor varieties. This means that if the grower of good varieties is really to capitalize on their rating in the market he must be a good producer.

On the other hand, when the average net returns per bushel to the grower for the different grades of the 25 lowest-priced varieties are compared with those of the 25-highest-priced varieties it is clear that the only possible chance that the man who is raising the low priced varieties has of making a net profit is in the production of a high percentage of A-grade. The B-grade fruit of the higher priced varieties sells for almost as much as the A-grade of the poorer varieties. Considered from another angle, it may be said that the low priced varieties must be sold at prices that will net the grower returns little above those of a "bulk" product, even though his orchard soil conditions and management methods are such that he raises rather good fruit.

HOW THE DIFFERENT VARIETIES GRADE OUT

Table 5 presents data on the way in which fruit of 75 varieties has graded out during the five-year period under discussion. Most of this table is self-explanatory. Thus the figures in the first row at the head of the table show that 47 per cent of all the fruit sold by the 137 growers from whom these records were taken was A-grade, 16 per cent B-grade and 20 per cent C-grade. Three per cent of their entire crop was sold as canner stock, three per cent as unclassified fruit, and 11 per cent in bulk.

These figures were obtained by averaging the corresponding percentages for all the individual growers, not by determining the percentages of the whole out-put of the total A-grade fruit and fruit of other grades. In this way, the small grower's grades received the same consideration as those of the individual producing twice or ten times as much fruit and a much fairer comparison of varieties is possible. The grading figures for the individual varieties were calculated in the same way.

The columns headed "Average rating" and "Corrected rating" require explanation. By "Average rating" is meant the average percentage of A-grade fruit of all varieties produced by those individuals raising that particular variety. Thus the average rating of 44 for the 51 Jonathan growers means that, considering all the varieties in their orchards, these men produced a 44 per cent A-grade crop during the five-year period. This was a little below the general average for all growers of all varieties. Consequently Jonathan is given a rating of 54, or two per cent above its A-grade percentage, in the "Corrected rating" column. This assumes that if the Jonathan growers individually rated or averaged as high as all growers they would have produced 54 per cent A-grade fruit of that variety. The figures in this "Corrected rating" column seem to furnish a fairer index to the true grading-out qualities of the varieties than those in the A-grade column, though these last figures give the percentage actually produced.

Attention should be directed to the fact that probably in every instance the percentages of all grades except the C- or cider grade are higher than they should be and that the percentages for that grade are correspondingly

Table 5.—The grading out of different varieties.

Variety	No. of growers	Average rating	Total No. bus. grown	Percent A	Percent B	Percent C	Percent canner	Percent unclassified	Percent bulk	Corrected rating
All	137	45		45	18	20	3	3	11	45
Pound Sweet	10	43	573	66	16	15	0	3	0	68
McIntosh	26	48	3,239	67	13	11	0	5	4	64
Sweet Bough	29	40	1,366	58	23	11	0	4	4	63
Opalescent	8	46	3,421	63	22	12	0	3	0	62
Gideon	11	50	4,014	67	15	15	1	1	1	62
Cranberry Pippin	8	45	781	62	12	17	4	5	0	62
Duchess	95	47	104,305	63	13	10	7	3	4	61
Shiawassee	10	46	1,520	62	18	12	7	0	1	61
Black Gilliflower	11	45	612	60	22	16	1	1	0	60
Golden Sweet	20	40	1,377	53	32	9	1	2	3	58
Fallowater	27	43	4,627	55	20	12	5	3	5	57
Gravenstein	10	50	651	62	15	14	1	4	4	57
Twenty Ounce	19	46	1,314	58	18	17	2	2	3	57
Alexander	13	50	1,126	60	18	3	0	7	12	55
Delicious	10	42	1,237	51	13	15	6	6	9	54
Primate	10	38	585	47	25	23	1	9	0	54
Fall Pippin	50	43	4,694	52	22	20	1	3	2	54
Wolf River	23	48	14,992	57	12	18	1	5	7	54
Rhode Island Greening	85	45	44,065	54	21	15	3	3	4	54
Jonathan	51	44	14,802	52	22	16	2	3	5	54
Blenheim Pippin	1	45	215	52	20	19	0	7	2	54
Maiden Blush	51	45	7,724	52	20	23	0	2	3	53
King	71	43	17,771	51	20	13	3	4	9	53
Colvert	25	41	2,307	49	18	20	0	2	11	52
Hubbardston	64	47	25,237	54	18	14	2	1	11	52
Wealthy	81	48	26,520	54	25	16	1	1	3	51
Winesap	11	42	727	48	34	12	0	1	5	51
Stark	59	48	32,268	54	18	13	4	2	9	51
Chenango	16	47	2,561	52	33	8	1	2	4	50
Snow	45	44	6,867	49	23	18	1	1	8	50
Grimes	52	48	20,553	53	26	13	2	2	4	50
St. Lawrence	7	37	1,003	42	37	17	0	4	0	50
Red Astrachan	39	41	4,190	45	29	17	1	5	3	49
Belmont	3	50	263	54	22	21	3	0	0	49
Arkansas Black	2	52	300	56	26	18	0	0	0	49
Wagener	70	45	23,519	47	23	18	3	4	5	49
Northwestern Greening	7	50	1,200	53	11	9	6	2	19	48
Vandevere	11	41	2,115	44	19	28	2	7	0	48
King David	5	53	1,326	56	21	14	1	1	7	48
Canada Red	40	43	11,292	46	23	21	2	1	7	48
Yellow Transparent	40	45	15,754	46	36	13	1	2	2	48
Ontario	15	39	3,774	41	17	20	8	1	13	47
Rubicon	7	50	846	51	27	13	5	4	0	46
Seek-no-further	20	42	2,132	42	23	20	0	1	14	45
Spitzenburg	25	43	2,206	43	28	16	2	6	5	45
Sutton	7	46	2,433	46	18	24	2	2	8	45
Winter Banana	29	51	3,457	50	19	13	1	8	9	44
Tolman Sweet	63	43	6,813	42	26	24	1	3	4	44
Strawberry Pippin	13	44	614	43	35	18	3	0	1	44
Lady Washington	4	48	698	47	21	21	1	0	0	44
Golden Russet	58	44	9,674	43	27	21	2	3	4	44
Early Harvest	15	37	482	36	31	12	0	14	7	44
Cabashea	26	41	2,466	40	17	20	2	7	14	44
Ben Davis	52	44	12,775	43	18	18	1	3	17	44
Northern Spy	77	44	32,725	42	25	18	5	5	5	43
Mann	17	41	1,566	39	18	17	6	4	16	43
Geniton	11	40	722	38	29	25	0	0	8	43
Ribston Pippin	3	34	203	32	26	14	0	28	0	43
Red Streak	39	39	448	36	28	29	0	0	7	42
Baldwin	99	45	119,637	41	24	19	3	3	10	41
Yellow Bellflower	24	41	1,316	37	20	20	4	8	11	41
York Imperial	23	47	2,248	43	20	15	4	9	9	41
Swaar	14	36	640	33	21	29	4	2	11	41
Mammoth Black Twig	3	54	434	50	23	18	0	5	4	41
Phoenix	13	44	328	39	17	24	8	3	9	40
Cooper Market	5	42	368	37	27	26	7	3	0	40
Lowell	11	41	786	34	27	25	1	8	5	38
Pewaukee	9	44	2,052	36	16	7	0	4	37	37
Fall Jenneating	6	38	316	30	26	22	4	18	0	37
Roxbury Russet	38	47	3,214	38	26	23	1	9	3	36
Gano	6	50	567	39	13	8	7	2	31	34
Boiken	8	48	2,703	35	11	15	4	0	35	32
Rome	5	44	143	28	15	44	0	3	10	29
Runkelford	3	44	209	24	28	33	0	16	0	25
Rambo	21	42	752	20	29	39	1	0	11	23

lower. This is because most growers have usually had left over at the close of the harvesting season a certain quantity of cider grade fruit of mixed varieties. Much of this is windfall fruit which is simply credited to the grower as cider stock upon delivery at the fruit exchange. In individual cases, this has amounted to as much as 20 per cent of the entire season's deliveries.

This stock is accounted for in the average grades of all varieties for all growers, given in the first row of Table 5, but not in the remainder of the table showing grades for the different varieties. This explains why the average of the "Corrected rating" is higher than the average rating of 47 for all growers and all varieties. On the other hand, in the case of certain varieties a comparatively large percentage of the fruit has been sold as "unclassified" or in "bulk" because of the poor demand for the A- and B-grades of these varieties, when much of this might well have been graded out into A and B stock had the demand been different. The "Corrected rating" column and the other grading columns, therefore, are perhaps as much of an indication of the way the different varieties sell as the way in which they grew.

Still other allowances must be made and considerable judgment used in interpreting or drawing conclusions from these grading data. Trees of many of the varieties in the list are found only in the older orchards. Trees of certain other varieties are found only in the younger plantings. This alone is responsible for considerable differences, as is indicated in Table 6. The Rambo, Runkleford, Fall Jenneating, Roxbury Russet, Lowell, Phoenix, Swaar, and many others, even including Baldwin, Northern Spy, and Golden

Table 6.—Influence of age of tree on grade of fruit produced.

* GRIMES										
Tree age	No. of growers	Average rating	Total bus. grown	Percent A	Percent B	Percent C	Percent canner	Percent unclassified	Percent bulk	Percent A-grade (corrected)
13-20.....	13	45	6,487	54	27	9	0	6	3	54
21-35.....	5	50	4,565	53	28	18	1	0	0	48
Above 35.....	8	51	1,306	42	40	17	0	0	1	36
JONATHAN										
1-12.....	11	40	3,065	55	19	14	0	3	9	60
13-20.....	13	45	5,118	52	23	15	1	4	5	52
21-35.....	3	55	1,889	60	27	12	1	0	0	50
Above 35.....	3	50	850	50	22	22	0	5	1	45
DUCHESS										
13-20.....	18	45	30,740	63	7	14	10	3	3	63
21-35.....	10	47	10,685	65	10	12	10	2	1	63
Above 35.....	6	48	6,827	63	16	10	9	2	0	60
STARK										
13-20.....	8	50	6,541	61	18	14	0	4	3	56
21-35.....	4	58	4,263	71	13	13	1	0	2	58
Above 35.....	6	57	7,871	59	17	15	2	1	6	47

Russet, show up to disadvantage because of age. McIntosh, Opalescent, Gideon, Delicious, and a number of others have an undue advantage over the others for the same reason. Nevertheless it is evident that there are well marked differences between varieties. For instance, the Baldwin trees in these orchards will average about the same in age as the Rhode Island Greening, but there is a difference of 13 per cent in their "Corrected ratings."

Comparison of the table on grades with those on numbers of bearing trees and on average prices shows that until recently at least plantings have been based neither on price nor on the percentage of good fruit produced. Among those which have been more commonly planted in the older orchards and which at the same time have brought good prices and have graded out well are: McIntosh, Rhode Island Greening, Jonathan, King, Snow and Canada Red. Among the heavily planted sorts that have shown up rather poorly from the standpoint of grade are: Baldwin, Northern Spy, Ben Davis, Golden Russet, and Tolman Sweet; while Duchess, Hubbardston, Wealthy, Grimes, and Stark grade out well but are not in first rank from the standpoint of price. Wagener occupies a middle position from the standpoint of both market value and grading.

THE RELATION OF GRADE TO NET RETURNS

The way in which the fruit of a variety grades out when run over the sorting table greatly influences net returns. Apparently few growers, however, realize the full significance of this factor, especially when setting their orchards. Table 7 combines the data on grades presented in Table 5 and those on prices presented in Table 4 and shows the average net returns to the producer of the different varieties as delivered at the community packing house. These are "tree run" prices for everything harvested, even including the windfalls. No package or packing charges need be deducted, because the fruit is actually sold for enough higher price to take care of all those items. They are "net" in the sense of indicating exactly what the producer has received for all his fruit. The first column of figures gives the average net returns that the growers included in this study actually received during the five-year period under consideration. The second column giving "Corrected" figures more accurately represents the true comparative value of the "tree-run" fruit of the several varieties, for they take into consideration the fact that certain of the varieties are found principally in the better orchards while certain others were found principally in the poorer orchards.

The figures themselves need little comment. The 24 varieties that are included in the first third of the list constitute 66 per cent of the trees of bearing age and 76 per cent of those in the more recent plantings. The 24 varieties heading the list are certainly not equally profitable, for there are differences in their productivity, their hardiness, their susceptibility to disease, and in many other characters. Probably, because of these differences, some of the varieties in the lower-priced two-thirds of the list would prove more profitable. However, it would seem wise to limit future plantings to those that actually net the growers a relatively high return per bushel.

Table 7.—Average net value to growers of "tree run" fruit. 1921-1925 seasons.

Variety	Ave. net value per bu.	Ave. net value per bu. corrected
Delicious.....	\$1 04	\$1 07
Yellow Transparent.....	97	99
Sweet Bough.....	94	98
Jonathan.....	91	93
McIntosh.....	89	87
Golden Sweet.....	82	86
Rhode Island Greening.....	83	83
King.....	80	82
Snow.....	79	80
Opalescent.....	80	79
Spitzenburg.....	76	78
Northern Spy.....	78	77
Grimes.....	78	76
Canada Red.....	77	75
Baldwin.....	75	75
Shiawassee.....	77	75
Rubicon.....	79	75
Winesap.....	73	75
Golden Russet.....	73	74
Northwestern Greening.....	76	73
Chenango.....	74	72
Alexander.....	75	72
Duchess.....	73	71
Stark.....	73	71
Winter Banana.....	74	70
Wealthy.....	70	68
Tolman Sweet.....	65	67
Twenty Ounce.....	68	67
Cranberry Pippin.....	67	67
Ontario.....	63	67
Wagener.....	64	66
Mann.....	63	66
Vandevere.....	63	66
Black Gilliflower.....	66	66
Maiden Blush.....	63	65
King David.....	70	65
Cooper Market.....	63	65
Wolf River.....	65	63
Belmont.....	66	63
Pewaukee.....	62	63
Sutton.....	63	62
Red Astrachan.....	60	62
Colvert.....	60	62
Swaar.....	57	62
Seek-no-further.....	59	61
Hubbardston.....	63	61
Pound Sweet.....	60	61
Fallawater.....	58	60
Early Harvest.....	56	60
York Imperial.....	61	59
Gano.....	62	59
Yellow Bellflower.....	57	59
Gideon.....	61	58
St. Lawrence.....	54	58
Fall Pippin.....	56	58
Blenheim.....	56	58
Boiken.....	59	57
Cabashea.....	55	57
Phoenix.....	56	57
Ben Davis.....	56	57
Primate.....	55	57
Roxbury Russet.....	57	56
Ribston.....	50	56
Rome.....	52	53
Gravenstein.....	55	52
Geniton.....	49	52
Mammoth Black Twig.....	56	51
Lady Washington.....	50	48
Lowell.....	45	47
Arkansas Black.....	51	47
Runkelford.....	42	43
Rambo.....	41	43

RELATIVE PRODUCTIVITY OF SOME OF THE MORE PROMINENT VARIETIES

Profits, however, do not depend entirely on market price, on the way the fruit grades out, or even on the net returns per bushel of the "tree-run" product. They also depend to a large extent on productivity. High yields may make a medium-priced variety more profitable than some other variety that brings more per bushel. In a general way, growers recognize some varieties as relatively productive, others as unproductive; but there are many differences of opinion as to which belong in the one group and which in the other.

Reliable and strictly comparable yield records are obtained with difficulty. Some orchards have changed ownership. In some cases, part of the record has been lost or forgotten. In other cases, the records are complete but the trees of one variety may be in several age classes. The data from which the averages in Table 8 were computed are believed to be accurate. Only when there was no reasonable doubt regarding the amount of fruit harvested and the number and age of the trees producing it, were the figures included. The number of trees on which average yields are based is in some cases regrettably small. In each instance, however, the figures represent the average for a number of growers. In some cases, the blank places in the table indicate that no figures were available, in others that the numbers

Table 8.—Average yields for trees of different varieties and different ages.

Variety	Bearing trees under 13 years			Trees 13-20 years			Trees 21-35 years		Trees above 35 years	
	No. trees averaged	Weight'd ave. age of trees	Ave. yield bu.	No. trees averaged	Weight'd ave. age of trees	Ave. yield bu.	No. trees averaged	Ave. yield bu.	No. trees averaged	Ave. yield bu.
All trees of all varieties			1.02			3.01		4.92		6.64
Snow				65	17	3.72	13	11.50	96	10.20
Northern Spy				727	16	1.78	492	5.10	662	9.92
Grimes	422	11	.86	837	17	4.01	422	6.32	40	9.83
Rhode Island Greening							227	6.84	1,159	9.10
Ben Davis							381	5.60	387	9.61
Stark	425	10	.28	721	16	3.05	448	4.19	709	8.69
Hubbardston				639	18	2.92	559	4.18	114	7.13
Jonathan	2,553	9	.79	911	16	2.11	182	3.60	27	9.30
Baldwin							566	6.90	4,426	6.33
Wealthy	245	10	1.64	1,656	16	3.06	757	4.18		
Tolman Sweet				32	18	2.70	52	5.20	133	7.02
Duchess				6,712	16	2.58	1,695	4.43	650	6.40
King				282	16	2.90	183	3.20	464	7.40
Yellow Transparent	87	11	.59	578	16	2.64	221	4.50	32	3.05
Wagener	48	11	.41	1,016	17	1.70	223	4.10	656	4.67
Wolf River				276	17	2.10	425	5.01		
Canada Red				242	17	1.30	57	3.39	199	7.23
Alexander				36	19	2.40	33	3.40	18	5.50
Chenango				135	16	4.87			208	3.38
Golden Russet									324	5.30
Opalescent				230	16	4.05				
McIntosh				394	16	1.25				
Ontario	565	11	.67	193	17	2.90				
Sweet Bough				13	17	1.70				
Winesap	70	11	.34	263	16	1.24	22	1.20	28	3.60
Delicious	294	11	.70	1,027	13	.70				

were too small to be significant. Fragmentary yield records were obtained on most of the other varieties studied but they were from too few trees or too few orchards to be considered representative and hence are not included in the table. Probably none of the figures given is to be regarded as indicating exactly what the variety in question will average as grown in future plantings. It is believed, however, that they afford some measure of what to expect.

The most striking, if not the most surprising, fact brought out by the figures on yield is the extremely low averages. That the average annual yield of apple trees 13-20 years old in commercial orchards in the fruit belt of the state is only three bushels, that the trees 21-35 years average less than five bushels, and that those above 35 years of age average less than seven bushels is almost unbelievable. These figures, however, represent the averages for 42,665 trees, many of them located in the best orchards. They have been checked and rechecked to insure accuracy. Most growers would estimate their average yields considerably higher but unconsciously they think principally of their crop years and do not give full weight to off years and to non-bearing individuals during seasons of heavy cropping.

The lesson of these general or total yield averages is obvious. In the last analysis the producer's most important problem is production—so handling his orchard that it produces more nearly capacity crops. Only by so doing can he expect a turn-over that will pay fixed or overhead charges and fluctuating seasonal costs, and then net a profit.

Yield differences between the varieties for which data are available are pronounced, relatively much more pronounced than market price or grading-out differences between the same varieties. This means that relatively they are much more important for, though the grower's selling unit is the bushel and barrel, his producing unit is the tree and orchard. After all, it is returns per acre in which he is primarily interested and which determine whether the result of the season's operations is net profit or net loss.

Table 9 gives the computed average gross annual returns per acre to the grower for orchards of different ages and of the varieties listed in Table 8, for which yield records are available. In computing these gross returns, the average net values per bushel of "tree-run" fruit (see Table 7) are used and a uniform planting distance of 35 feet each way, giving 35 trees to the acre, is assumed. This probably allows more trees to the acre than are actually found in the average orchard, for though it approximates the average of planting distances, it does not take into account the vacancies that are so frequent, especially in the older orchards.

The figures in this table are generally self-explanatory and require little comment. It is interesting to note, however, that the sequence of varieties in this table (No. 9) resembles that in Table 8 (showing yields), much more closely than in Tables 4 and 5, giving average prices and grading out records. This comparison will serve to measure fairly accurately the relative importance of price, grading-out and yield in determining returns and profit or loss. It is evident also that the earliest bearers are not necessarily the heaviest bearers later on and that varieties which are slow in coming into bearing may be far more profitable in the long run.

Few experienced growers will glance over this table without surprise at some of the figures. As a matter of fact, there are many upsets to the rather hazily-accepted rating of some of these prominent varieties. That Rhode Island Greening, Northern Spy, and Jonathan are near the head

Table 9.—Average total income per acre for "tree run" fruit. 1921-1925.

Variety	Bearing trees under 13 years	Trees 13-20 years	Trees 21-35 years	Trees above 35 years
Snow.....		\$84 25	\$322 00	\$285 25
Rhode Island Greening.....			198 80	264 50
Grimes.....	\$22 75	106 75	168 00	261 50
Jonathan.....	25 55	68 50	117 35	302 75
Northern Spy.....		48 00	137 50	267 50
Baldwin.....			181 00	166 00
King.....		83 25	91 75	212 00
Yellow Transparent.....	20 30	91 25	156 00	105 75
Ben Davis.....			111 65	191 50
Stark.....	7 00	76 00	104 00	176 00
Canada Red.....		34 00	89 00	189 75
Tolman Sweet.....		63 40	121 80	164 50
Wealthy.....	39 20	72 80	99 50	
Duchess.....		64 25	110 00	159 00
Wolf River.....		46 50	110 25	
Alexander.....		60 75	85 75	138 50
Hubbardston.....		62 30	89 25	130 00
Wagener.....	9 45	39 20	94 50	107 75
Chenango.....		122 85		85 00
Golden Russet.....				137 25
Ontario.....		68 00		
Sweet Bough.....		58 50	41 25	88 50
McIntosh.....	20 30	38 15		
Delicious.....	26 25	26 25		
Winesap.....	8 75	32 55		
Opalescent.....		112 00		

Note:—The figures in columns 2 and 3 are not strictly comparable to each other, as the weighted average ages of the trees from which the records were made varied somewhat (see Table 8).

of the list would be expected. That Snow heads the list would be guessed by few. That Ben Davis and Stark rank so high will come as a surprise to some; others would expect it. That McIntosh appears so low in the list will come as a distinct jolt to most growers. To many, it will be almost unbelievable that during the past five years Wagener has averaged higher returns per acre than McIntosh, yet the Wagener records are from 44 orchards and involve 1,943 trees; the McIntosh records are from 18 orchards and for 959 trees that average a trifle less than the Wagener trees in age. It will be said that something is wrong. Something probably is wrong but it is with the orchards, as will be brought out later, and not with the figures.

In closing this general discussion of varieties, it should be stated that even these figures on average total income per acre for "tree-run" fruit during a representative five-year period do not tell the whole story. They do not furnish a completely accurate guide for future plantings. They are important, very important, but other factors must be considered. Some of these will be pointed out in the following detailed discussion of individual varieties.

A CONSIDERATION OF INDIVIDUAL VARIETIES

Summer and Early Fall

Of the 129 apple varieties that make up the commercial orchards of bearing age studied in this investigation, about one-fifth may be classed as summer or early fall sorts. These constitute approximately one-third of the orchard acreage and have yielded one-fourth of the total tonnage during the five-year period under consideration. Only nine summer and early fall kinds appear in the list of varieties found in the non-bearing commercial orchards and these constitute only ten per cent of the new acreage. This change in the seasonal complexion of the state's commercial apple orchards is plainly as it should be.

The period during which summer varieties can be marketed is short. They come into direct competition with many other summer fruits—raspberries, blackberries, peaches, plums, dewberries, cantaloupes, watermelons, and to some extent early pears and grapes—for most of which the relative demand is increasing. Earlier shipments of the same varieties from regions to the south have dulled the demand before our product can be harvested. A large per cent of this early crop is used for culinary rather than dessert purposes. Relatively (that is as compared with later ripening sorts) these varieties have been overplanted. Together these things account for comparatively low prices. In the northern counties, especially, caution should be exercised in the planting of summer varieties. When their Duchess are maturing, the Wealthy harvest is on in southern counties. This competition between varieties forces the northern growers to accept lower prices than the growers of southern Michigan received a week or two earlier. The situation obtaining in 1924 and 1925, when shippers south of Grand Rapids averaged approximately \$1.17 per bushel for their A-grade Duchess and growers north of that point averaged about \$0.91, is typical.

On the other hand, there will always be a brisk demand in local markets for high grade early apples. It is this demand, rather than the demand for carlot shipments, that should govern their planting in all except a few of the southern counties.

Yellow Transparent—Next to Delicious, this variety has averaged the highest in price during the five-year period covered by these records. For 50 years it has ranked second in importance among summer varieties. It comes into bearing young, but it is only moderately productive. It grades out fairly well, though it is inclined to run small and shows handling bruises as markedly as any variety. The tree is hardy but very susceptible to blight. It is the earliest of the commonly grown varieties to mature but its season is very short. It is doubtful if its further planting can be recommended for other than local markets.

Duchess—The bearing orchards of Michigan contain more trees of Duchess than of any other single variety, though the total annual production falls somewhat below that of Baldwin. The variety, however, constitutes less than four per cent of the newer commercial

plantings. These facts reflect the general opinion, which is that there has been overplanting of this variety, especially in the northern part of the state. The variety is in disfavor largely because growers are often forced to sell at unsatisfactory prices. As a matter of fact, the average prices given for this variety in Tables 4 and 7 tell only part of the story. They indicate what the growers actually received for what was sold, but are not averages for what was raised, for during the period in question, many thousands of bushels were not harvested because of glutted markets. This has been true of Duchess to an extent that does not hold for any other important variety. The tree is hardy and vigorous, comes into bearing young and over a period of years may be expected to produce average crops. Few records are available of really large average yields. The fruit grades out well. Many Duchess trees, especially in northern Michigan, have been top worked to other varieties during the last few years and there is good reason for top working many more. Undoubtedly, many growers have made money with Duchess, but further commercial plantings cannot be recommended.

Wealthy—In the bearing orchards Wealthy ranks second in total number of trees and in total production among the summer varieties and in the newer plantings it takes first place. The tree is hardy, grows vigorously while young, comes into bearing at an early age, and ranks with the average in productivity. As with Duchess, in none of the 67 orchards included in this study which furnished yield records for this variety did the trees maintain an unusually high average yield over the entire five-year period. Some orchards have yielded fairly heavily in certain seasons but the trees are much inclined to biennial bearing and this reduces the average. Mature trees are below rather than above medium in size.

The fruit grades out somewhat better than the average variety. Prices have averaged moderately high. Its slowly gaining ascendancy in the summer apple group is warranted by its record. It has made the producer money. Its commercial planting in a conservative way can be recommended, though it should be remembered that apples of this class are more profitable when grown for comparatively near-by markets than for distant carlot shipments. Its early bearing characteristics together with its rather slow growth when once in bearing make it one of the most desirable varieties for filler planting where this practice is employed.

Chenango—This high-quality, attractive, dessert variety has never been planted extensively, though it is to be ranked as a commercial sort. Its average yield has not been different from that of the general run of varieties, though in several orchards it has made exceptionally fine records. It grades out somewhat better than the average and has brought reasonably satisfactory prices. Chenango is essentially a dessert fruit and the demand for a variety of that class while it is in season is limited. Its commercial planting except in limited quantities for local markets is not warranted.

Maiden Blush—This variety is found principally in the older orchards. The tree comes into bearing rather young and on the whole is about average in productivity, though there are a few orchards where uniformly high yields have been obtained. It grades out well, but brings

only average prices. It is used almost exclusively for culinary purposes and must compete with better kinds. The demand may be expected to decrease rather than increase. Its planting is to be discouraged.

Red Astrachan—Red Astrachan is found principally in the orchards above 35 years of age. The tree is productive and when well cared for produces fruit that grades out well. However, its marketing season is short, the demand is limited, and prices have been rather low. Future planting is to be discouraged.

Livland Raspberry—Price, grading out, and yield data are not given for this variety in Tables 4, 5, and 7 for the reason that it has not been widely set in Michigan in the sense of being found in many orchards. However, there are a few rather extensive plantings and a number of records were obtained. The fruit is of high quality and has brought fair prices, but the trees have uniformly proved to be unproductive. It can be unconditionally condemned for commercial planting.

Colvert—Colvert, or Culver as it is more commonly known in Michigan, is found in small numbers in the older orchards. It has proved medium in productivity and has graded out well. However, it has brought rather low prices and is not included among the profitable kinds.

Sweet Bough—This variety is found principally in the older orchards, though it is still being sparingly planted. It is medium or below in productivity but the fruit grades out especially well. It has brought exceptionally high prices, principally because only a few have been available. The demand for an early sweet apple is extremely limited and no further planting is warranted.

Unimportant Summer Varieties

Early Harvest, Benoni, McMahan, Pimate, Lowell (Greasy Pippin), Gravenstein, St. Lawrence, Strawberry Pippin, Jefferis, Porter, Red June, Pumpkin Sweet, and Bailey Sweet are all varieties found only in small numbers and principally in the older orchards. Nothing in the limited data that are available would recommend the above varieties for future planting. It is fortunate that apparently they are scheduled to disappear from commercial plantings in Michigan with the gradual disappearance of the older orchards.

The Late Fall and Winter Varieties

No clear and sharp line can be drawn between what is here termed the *more prominent* and the *less prominent* late fall and winter varieties. If the classification were to be based on total volume of fruit produced during the past few years the division line would be different than were it to be based on numbers of bearing or of bearing and non-bearing trees. In this instance, the classification takes into consideration all these factors but the division line is necessarily arbitrary. In a general way, the varieties included in the first group will be recognized as those actually being raised in largest amounts or being planted in largest numbers. It should be distinctly understood, however, that this arbitrary division line should not be interpreted as meaning that the varieties in the one group are any more or any less profitable

than those in the other or that they are to be any more or any less generally recommended for planting.

The More Prominent Kinds

Baldwin—Michigan has always been considered Baldwin, Spy, and Greening territory and rightly so because these varieties have always constituted an important part of the orchard acreage of the state. Approximately one third of the trees over 35 years old are Baldwins. Nearly ten per cent of the present trees of bearing age are of this variety. It looms up less prominently in the plantings that have not yet reached bearing age, constituting less than three per cent of their population. Clearly, it has been losing in popularity, though the records show that it has been far more profitable than three-fourths of the other winter varieties alongside of which it has been grown.

The tree is a vigorous grower, attaining large size. It is not generally thought of as tender to cold but as a matter of fact there is abundant evidence that it is rather susceptible to winter injury, especially at the collar. Its tardiness in coming into bearing and pronounced biennial habit are well known but the records show that its productivity is fully up to the average. For many growers, it has done exceptionally well.

The records obtained in this study show that one block of 45 23-year old trees has averaged 11 bushels to the tree for the five-year period; another block of 300 40-year old trees has averaged 14.4 bushels to the tree during the same period. There are few records equal to or better than these for any of the other varieties. On the average, the fruit grades out rather poorly, sometimes because of poor coloration, sometimes because of the bitter pit or Baldwin fruit spot, more frequently because of small size. It is not thought of as a fancy dessert apple; as a matter of fact it is used primarily for culinary purposes. Nevertheless, it has uniformly brought relatively high prices.

Taking everything into consideration, Baldwin has probably brought the Michigan growers more net profit than any other two varieties. It is proving more profitable than any other variety for some growers today. This, however, does not mean that it is to be universally or indiscriminately recommended. Rather it is to be recommended for somewhat special conditions. Only where the soil is deep and "strong," the water table low and consequently where deep root penetration is possible can heavy yields and good grades be expected. These of course are characteristics of a good soil for other varieties, but many varieties are not so exacting in their requirements. Combine exceptionally good environmental conditions, good soil management methods, the usual thorough spraying, and judicious pruning to develop size of fruit and to promote its coloration and this variety will be found among the most profitable.

Rhode Island Greening—For two generations Rhode Island Greening, or Greening as it is more commonly called, has ranked second in importance in Michigan among winter varieties from the standpoint of total production if not from that of tree number. For a while, its popularity evidently waned but more recently planting interest was

renewed and the non-bearing orchards of today include enough trees to guarantee it a respectable place in the production of the future.

The tree is a vigorous, rather coarse grower, attaining great size. It is to be classed as moderately hardy, and it is rather slow in coming into bearing, though not so slow as Baldwin. It is one of the most productive varieties grown in the state, low yields being the exception, and very high yields being rather common. In a number of the older orchards included in this survey, blocks of trees of this variety have averaged upwards of 15 bushels apiece for the entire five-year period, whereas in only three orchards have the average yield of trees of all varieties over 35 years of age been 12 bushels or above.

The fruit grades out well and has consistently sold for relatively high prices. It is unquestionably one of the most profitable varieties grown and can be unhesitatingly recommended for future planting. It should constitute a relatively higher percentage of the new plantings than it does in already established orchards.

Northern Spy—As already indicated, Northern Spy has always ranked as one of the "big three" in Michigan's winter apple industry, though the fact that it constitutes only a little over five per cent of the bearing acreage in the orchards studied would seem to belie that statement. That its relative worth is being better appreciated is indicated by the fact that it constitutes nearly ten per cent of the present non-bearing acreage.

The tree is the slowest of all the important commercial varieties to come into bearing but, when once well into bearing, it ranks with the best in productiveness. It is vigorous and probably hardy enough for most of the commercial apple growing districts of the southern peninsula.

The fruit does not grade out any too well, owing principally to the ease with which its tender skin is bruised. It is likewise rather susceptible to scab and not infrequently grades down because of poor coloration. Its standing in the market is the best; it sells when the demand for many other varieties is sluggish and its average price is relatively high. There is no question but that it is one of the most profitable varieties grown in Michigan.

In spite of its tardiness in coming into bearing, it can be unhesitatingly recommended for commercial planting. Incidentally, it may be stated that it is not invariably or necessarily a tardy bearer. There is an authentic record of a group of ten trees in one Michigan orchard, set in 1910, that averaged 12.4 bushels per tree per year during a six year period beginning with their eleventh season. No unvarying rule can be given for bringing this variety into bearing early. However, observation leads to the belief that the choice of a relatively deep fertile soil, and clean culture followed by a sod-mulch system of management supplemented with fertilizer is good procedure for this variety.

Grimes—Grimes is found in some of the oldest commercial orchards of the state and has gradually come to occupy a more prominent place in later plantings. It constitutes over seven per cent of the present non-bearing acreage tabulated in this study. This is more than double its percentage in orchards of bearing age.

The tree is a moderately vigorous grower, hardy in bud and limb, but characteristically tender at the crown. For this reason it has suffered

from collar rot, especially while young. It comes into bearing young and ranks along with the best in productivity as the tree becomes older. This is in marked contrast to certain other varieties such as Wagener and Yellow Transparent, that are likewise early producers.

The fruit grades out reasonably well and, in spite of much complaint about difficulty in selling it, has actually brought relatively high prices. Unquestionably, it has been a profitable variety.

In the light of its record, planting cannot be discouraged, though growers should be cautioned that during recent years sales agents have experienced increasing difficulty in disposing of it to advantage. On account of its susceptibility to winter injury at the crown, growers will find it desirable either to purchase double-worked trees or they should set some other variety known to be hardy at the crown and then top work a year or two later.

Wagener—In number of trees of bearing age, Wagener takes third place among the winter varieties: it drops to sixth place in orchards of non-bearing age. These figures reflect a waning popularity.

The tree is hardy and grows rapidly while young but soon slows down and eventually makes only a more or less semi-dwarf tree. It is generally thought of as a very heavy producer, probably owing to the fact that it comes into bearing young. As it becomes older, however, it rather uniformly drops below the average in productiveness, because of its relatively slow growth and a marked biennial bearing habit.

It grades out about with the average and sells at little better than average prices. It has made money for many growers but it is distinctly less profitable than a number of other varieties. It does much better in the northern than in the southern part of the state and it may be questioned if it should be much planted commercially south of Grand Rapids. Its early bearing and semi-dwarf habit recommend it for a filler where this system of planting is employed.

Hubbardston—Hubbardston constitutes over seven per cent of the trees over 35 years of age in the orchards covered by this survey. It makes up about three per cent of the younger bearing orchards and about the same percentage of the present non-bearing acreage.

The trees are moderately vigorous, reasonably hardy, are about average in coming into bearing, and do not vary much from the general average in later productiveness. The fruit grades out fairly well but generally must be sold at prices distinctly below the average. The records show that it ranks along with Wagener in average returns per acre. Some growers have found it moderately profitable; many have not. Its general planting cannot be recommended.

King—Trees of this variety are found in considerable numbers in the orchards of bearing age. Very few have been included in the recent plantings. The tree is a vigorous grower and becomes very large. Like Baldwin it is rather susceptible to winter injury at the crown. It is rather slow in coming into bearing and for many years after reaching bearing age produces rather sparingly. Eventually, however, it makes a productive tree.

The fruit grades out well, in spite of marked susceptibility to water-core, and it rather uniformly sells for relatively high prices. Prin-

cipally on account of its slowness in reaching full bearing and partly on account of its marked susceptibility to blight it cannot be recommended for general planting.

Golden Russet—Apparently this old standard is practically limited to the older bearing orchards. None of the 100 orchards for which tree population records were obtained contained Golden Russet trees under 35 years of age nor was a single Golden Russet included among the 60,000 listed as of non-bearing age. It is one of those varieties that growers recommend to others but do not plant themselves. Consequently it may be expected to occupy a less prominent place in the production of the future. Though it brings a good price, it grades out none too well.

In some quarters it has the reputation of being a heavy producer and some high yield records are available. However, in average yield and in average returns per acre it ranks well below Baldwin, Greening, Spy and several others. Cold storage, which has made possible the late holding of a number of other varieties, narrows the field that varieties of its class once had more or less to themselves. Whatever else may be said about this variety, it is plainly disappearing, and probably its passing is not to be lamented.

Canada Red—Canada Red, or Steele Red as it is more commonly called in Michigan, has never occupied a very prominent place in the list of commercial apple varieties, though it has always been recognized as a standard sort. In the newer plantings, it looms up much more prominently, taking rank with Wealthy and Duchess and forging ahead of Baldwin, Rhode Island Greening, and Hubbardston.

The tree is rather slow in coming into bearing. Some excellent yield records for older trees are available but on the whole it has shown up about with the average in this respect. It grades out none too well, largely because of small size incident to over-bearing on heavy crop years. However, it uniformly brings relatively high prices and has been profitable. It is not a variety to set in large quantities along with only one or two others for carlot shipment.

On the other hand, it is unexcelled as a late sort for the individual grower or the organization that plans on producing a steady supply covering the entire season. Indeed it has few real competitors when it is at its best. The fact that the apple industry of the state is likely to develop more and more in this direction guarantees Canada Red an increasingly important place in future production. In brief, it is a variety that has a definite place in a well ordered scheme of planting and distribution—not dominant but none the less important.

Tolman Sweet—Like Golden Russet and a number of other varieties, Tolman Sweet is practically limited to the older orchards and, though these old trees will for many years continue to furnish a considerable volume of fruit, the variety seems destined to disappear from the commercial list.

The tree is hardy and a good grower and has proved average or somewhat above in productiveness. In fact, some exceptionally high average yields appear in the records that have been collected. However the fruit has not graded out any too well and has brought barely average prices. Though without doubt it has been a reasonably profitable

variety, the very limited and apparently decreasing demand for a winter sweet apple makes further planting inadvisable.

Fall Pippin—In number of trees, this variety does not rank very high, but since most of them are old and relatively productive the total quantity produced is a factor of some importance in the apple deal. The fruit grades out well but, though of high quality, sells at low prices. The variety is relatively unprofitable and no further plantings is warranted.

A number of closely related varieties such as Holland Pippin and Short-stemmed Pippin, which are often grown and sold under the single name Pippin, usually bring still lower prices. They are relatively less profitable and are likely to disappear from the commercial lists.

Ben Davis—Ben Davis makes up about five per cent of the commercial apple plantings above 35 years of age and a distinctly smaller percentage of the younger orchards. Apparently, its planting practically ceased about 1900, those desiring something of that type turning to Gano or Black Ben Davis. The small percentage of the tree population that it constitutes would at first seem to relegate it to an unimportant position, but this is not the case.

The trees are relatively very productive and contribute a generous quota to the state's annual crop. The grading records of this variety, as given in Table 5, illustrate the statement that was made earlier to the effect that in some cases they measure the way a variety sells rather than the way the tree produces. Large quantities of Ben Davis are sold in bulk, not because it is a rather poor grading fruit but simply because it finds a more ready sale in this grade.

The average price per bushel is low but the average returns per tree and per acre have been high. No variety has been more condemned than Ben Davis—and perhaps justly. Few varieties have yielded growers greater profit. Growers have not been setting it during recent years and should refrain from setting it in the future, not because it is not profitable but because there are a few better varieties that are more profitable and because there is a well founded belief that general apple consumption will be stimulated to a greater extent by these better varieties than by varieties of the Ben Davis class. It is the Ben Davises and Starks that help the grocer sell oranges and grapefruit.

Stark—It may come as a surprise to some that Stark greatly exceeds Ben Davis, both in tree number and in volume of fruit produced. The old orchards contain as many trees and the younger many more. Furthermore there is a considerable number of Stark trees in the non-bearing orchards, though the percentage is lower than it is in the older.

The tree is vigorous, comes into bearing reasonably young and continues productive, considerably above the average in this respect. Like Ben Davis, it is comparatively easy to grow. The fruit grades out moderately well and has sold for a fair average price. All these factors have contributed towards making it a profitable variety.

However, there are several varieties that, yielding more and better fruit and being consequently more profitable, should receive preference for general planting. On the other hand, it is possible that, until

something better is introduced, it may have a place as a late winter and early spring culinary variety in the orchards of those who wish to cover as much of the marketing season as possible. It is a variety, however, that should be encouraged, if at all, only for a limited special trade, because it too closely approaches Ben Davis in quality to stimulate the general demand for apples.

Wolf River—Trees of this variety are found principally in the orchards from 15 to 25 years old and they constitute only a very small percentage of the trees of non-bearing age. The tree is very hardy, a coarse grower and eventually attains great size. It is rather slow in coming into bearing but finally ranks with the average in production. Though the fruit grades out fairly well it sells at prices below rather than above the average. For the grower who is successful in finding for it a special market, such as the baked apple trade, it may prove profitable but it is not to be recommended for general planting.

Winter Banana—This variety was somewhat more generally planted than Wolf River in the older orchards and many more trees comparatively are found in the present non-bearing orchards. However, it has never been a dominant variety and the evidence indicates that it is gradually losing in popularity. The tree is a medium grower, comes into bearing rather young and ranks with or slightly above the average in productiveness.

The fruit is very subject to scab and shows handling bruises badly. On the average, it does not grade out very well and prices are along with the average. In the hands of a few growers, it has proved profitable. It is not a variety that can be recommended for general planting.

Snow—There are few if any large plantings of this variety but so many orchards contain a few trees that the total crop is considerable. Furthermore the more recent plantings assure it an increasingly important, though by no means outstanding, place in future production. The tree is a hardy, good grower and one of the most uniformly productive of any of the varieties studied. The fruit grades out reasonably well and brings a good price. It is well and favorably known and seldom is there difficulty in finding a market for it.

The question has been raised whether the increasing production of McIntosh will not result in a decreased demand for Snow. Such a situation may develop but there is nothing to indicate that it need be feared in the near future. The variety has been one of the most profitable and its further planting can be recommended. It reaches an especially high degree of excellence in the more northern portions of the state.

McIntosh—Probably McIntosh should be classed with the newer kinds for there are few trees of this variety in Michigan over 20 years of age. Within that short time, however, it has come to occupy a most prominent place. It constitutes nearly 14 per cent of all the trees of non-bearing age, ranking second only to Jonathan in this respect. Seldom in the annals of Michigan horticulture has a new variety gained such general recognition so quickly; nor is this popularity undeserved. Few, if any, varieties rank ahead of it in quality and attractiveness and in cold storage it keeps well beyond the holiday season.

The tree is hardy and vigorous and thrives on a wide range of soils.

Apparently it does almost equally as well from the Michigan-Indiana line to the Straits. It comes into bearing young and in many orchards is proving a good cropper. It must be admitted, however, that the yield records of the orchards covered by this study show rather low average production. There is some reason to believe that this is due at least in part to unsatisfactory provision for cross pollination. McIntosh is at least partially self sterile and should be interplanted with other varieties that blossom at the same time if a good setting of fruit is to be obtained.

Thus far, the fruit of this variety has graded out extremely well, due in part to its having come entirely from young trees. There is every indication, however, that it will continue to grade out well. It brings high prices and the demand is growing.

Whether or not the large production that may be anticipated from the trees already set and not yet in bearing will bring a slump cannot be foretold. The only other district where it is being heavily planted is New York and New England and this district is not a close competitor in Michigan's natural trade territory. Furthermore, the home market for this variety can be greatly developed. Its further planting can be recommended, not to the exclusion of others, but conservatively.

Delicious—It was said of Ben Davis that no variety has been more generally condemned and few have been more profitable. Conversely it may be said of Delicious that in Michigan no variety has been more enthusiastically praised and few have proved less profitable. It is one of the newer varieties, there being few trees in Michigan over 15 years of age, but it ranks third in number of non-bearing trees. This almost phenomenal rise in popularity is due to the wide advertising it has received, to the high quality and attractiveness of its fruit and to the exceptional prices that it has brought rather than to any enviable record it has made as a producer in commercial plantings in Michigan.

The tree is hardy and a good grower. It is somewhat slow in coming into bearing and its average yields have been low. One orchard of 909 trees, 609 of which were set in 1911 and 300 in 1913 yielded 85 bushels in 1922, 600 in 1923, 300 in 1924 and 942 in 1925, an average of only one-half bushel per tree per year for the four-year period. Another orchard of 486 trees set in 1912 produced a total of 382 bushels in 1923, 618 in 1924 and 30 bushels in 1925. These are typical instances. On the other hand, one orchard of 170 trees 11 years old in 1925 produced 47 bushels in 1922, 147 in 1923, 477 in 1924 and 300 in 1925 and another orchard of 32 acres produced approximately 1,500 bushels in its tenth year. In this last orchard individual trees have averaged six to ten bushels each for three consecutive years following this tenth season's record. These instances indicate that the variety is not universally or necessarily a shy bearer under Michigan conditions. Circumstantial evidence indicates that in many cases low yields have been due to unsatisfactory provision for cross pollination. Apparently Jonathan is a very good pollenizer for this variety.

Delicious grades out well when well grown, but apparently requires greater care in pruning and spraying than the average variety. It has headed the list in price and will probably continue to for many years.

However, with increasing production the margin between this and some of the other varieties will undoubtedly become narrower.

Other sections, especially the northwestern states, have been planting Delicious heavily. Relative to other varieties its production will increase enormously and there will follow greatly increased competition in general markets. This does not hold to nearly the same extent for a number of the other varieties. Further planting of this variety in Michigan for the general markets cannot be recommended. Its limited planting for local markets is to be encouraged. At the same time, there seems little question but that a dozen other varieties will net the producer equal or greater profits.

Jonathan—Jonathan ranks second in number of trees of bearing age and first among those not yet in bearing in the orchards included in this study. It is the only one of the older varieties that has shown a steady increase in popularity from the earliest commercial plantings to the present time.

The tree is a moderately vigorous grower and reasonably hardy, but rather susceptible to blight. It comes into bearing young and ranks with the average in productivity when once well into bearing. Cases of heavy bearing for a term of years, however, are uncommon. It grades out distinctly better than the average and sells for relatively high prices.

Unquestionably it is one of the most profitable varieties that is grown in Michigan and its popularity is warranted. However, it is not without its faults. In the northern part of the state, it is very much inclined to run small and it is doubtful whether it should be much planted north of Grand Rapids. On the other hand, it is doubtful whether other varieties will surpass it in the more southern counties. Furthermore competition with Jonathan from other districts will probably not increase, for it is doubtful if the new plantings in Illinois and the Ozarks will compensate for the reduction in acreage in the northwest where it has been raised in great quantity and is now giving way to Winesap, Delicious and certain other varieties.

It should be mentioned that it is susceptible to two or three forms of storage scald and "break down" that set a fairly definite limit to its practicable marketing season. It should be moved before the holiday season if the grower is to "play safe."

The Less Prominent Kinds

Gideon—In number of trees and in total production, Gideon ranks first among the late fall and winter varieties that have been grouped more or less arbitrarily as "less prominent kinds." However, comparatively few trees of this variety have been set recently. The trees have ranked with the average in productivity and their fruit has graded out exceptionally well, but it has sold at low prices. Compared with some of the other varieties it is unprofitable. No further planting can be encouraged and probably it would be better if most of the trees of this variety were top worked to something else.

Ontario—Ontario is found principally in orchards under 20 years of age. There are, however, a number of medium sized bearing plantings and it is found in considerable numbers in orchards not in bear-

ing. The tree is a good grower and neither particularly early nor particularly late in coming into bearing. Once in bearing, it averages above medium in productivity. The fruit grades out about with the average and sells at prices below the mean price for apple varieties. Further planting is to be discouraged.

Roxbury Russet—Though this variety was extensively planted in the days when apples of its class were prized for their late keeping qualities, it is not found in recent commercial plantings. Like the Golden Russet it has yielded moderately heavily but its fruit grades out much poorer than that variety and it sells at a lower price. Its disappearance from the commercial list is certain and can come none too soon.

Spitzenburg—Like Golden Russet and Roxbury, Spitzenburg is found only in the older orchards. So far as Michigan horticulture is concerned it belongs in the class of "has beens." In some ways, this is to be regretted for it is of exceptional quality. However, the tree is barely average in productivity and is very susceptible to blight. Though the fruit grades out moderately well it does not reach a degree of excellence that enables it to compete with the fruit of the same variety produced in the Northwest. It brings relatively high prices but compared with other sorts the variety is not profitable.

Fallwater—Tree for tree, this variety has probably been about as profitable as any variety that is grown, for the trees are very productive and the fruit grades out exceptionally well. Apparently, the relatively low prices received for the fruit have discouraged its planting. Further planting is not warranted.

Cabashea—Cabashea or Cabashaw as it is more commonly known in Michigan, is another variety that has had its day. Few trees under 35 years of age are found. Though the trees are relatively productive, the fruit grades out none too well and it has brought relatively low prices. It has no place in planting plans for the future.

Yellow Bellflower—Though this variety never constituted an important part of any commercial plantings in Michigan it is rather commonly found along with Baldwin, Rhode Island Greening, and Northern Spy in the older orchards. It is below medium in productivity, poor in grade and low in price, and its disappearance should occasion no regret.

Golden Sweet—Golden Sweet has been a profitable variety, probably largely because the very limited production has barely supplied the demand. However, any considerable increase in production would result in an over-supply for the limited demand for a variety of this type. Further planting is not recommended even though the old trees of this variety have made a rather enviable record.

York Imperial—This variety has the reputation of being one of the most profitable kinds in a latitude 500 miles to the south of this state. In Michigan orchards, it has proved relatively productive, but as grown here it grades out poorly and has sold for comparatively low prices. It should not be planted in this state.

Winesap—Winesap is another variety that is far better suited to more southern than to Michigan conditions. Nevertheless it has been considerably planted in this state and young trees of this variety are rather numerous. As raised here the fruit has graded out reasonably

well and it has been up to the average in productiveness. Canada Red is a far better variety of its season for Michigan conditions.

Vandevere Pippin—Though never heavily planted, trees of this variety have generally given a good account of themselves. The fruit has graded out moderately well and brought average or slightly below average prices. There are far better varieties for commercial planting.

Seek-no-further—Seek-no-further, or perhaps more properly Westfield, is another of the "has beens". As an orchard tree, it has performed satisfactorily, but its grading records are only average or below and the fruit has not brought good prices.

Sutton—Never very prominent in Michigan, this variety is represented by a number of moderate sized plantings. The trees have yielded well, but the fruit has graded out only average and has sold for rather low prices. There is no occasion for further planting.

Rambo—This old favorite is perhaps to be classed more as a home orchard than as a commercial variety, for plantings are generally small. However, a considerable volume of fruit finds its way on the market annually. It grades out poorly, brings low prices and the trees have little to recommend them from the standpoint of yield. The trees of this variety are a liability rather than an asset to the shipping part of the industry.

Shiawassee—This rather local variety is grown probably to a greater extent in Michigan than anywhere else. However, it has never assumed a place of considerable importance. Its high quality recommends it, but both Snow and McIntosh, which it resembles, are better and more favorably known. It has to compete with those varieties and is not doing so successfully. It is not recommended.

Twenty Ounce—Never extensively planted, Twenty Ounce has nevertheless been generally recognized as a rather high quality fall apple. It grades out well but brings barely average prices. The few yield records that are available do not indicate anything exceptional in that respect. Further planting cannot be recommended.

Alexander—This close relative of Wolf River ranks with that variety in the way in which it grades out and has averaged distinctly higher in price. Yield data are too fragmentary to warrant drawing definite conclusions but apparently it is about equal to that variety in productivity. It would appear to be a more profitable variety to grow but, as stated in the discussion of Wolf River, there is no occasion for any general planting of a variety of this type.

Pewaukee—Though apparently a good yielder, the relatively low prices it brings, the poor way in which it grades out and its characteristic of dropping badly from the tree at or shortly before maturity, all contribute to make it relatively unprofitable. There is no occasion for planting it.

Boiken—Fortunately, Boiken has been little planted. The trees are productive, but the fruit grades out poorly and sells for low prices.

Northwestern Greening—Though the total volume of fruit which has been produced of this variety is not great, it must be reckoned among

the commercial sorts. The tree is very hardy, a good grower, comes into bearing rather young and in some orchards has proved extremely productive. It grades out fairly well and has sold at higher average prices than one would expect for a variety of its dessert quality. It is, however, an excellent cooking apple. It is doubtful if any extensive planting is to be recommended, but the evidence indicates it would prove far more profitable than half the varieties that are being grown or than many of those now being set in commercial orchards.

Relatively Unimportant Kinds

As stated before, the lines between the several groups of varieties are drawn rather arbitrarily. Few would classify the varieties listed in this particular group as other than relatively unimportant and many might be inclined to list here a number of those that have been given greater recognition. In this group are: Arkansas Black, Beitigheimer, Belmont, Bismarck, Black Gilliflower, Blenheim Pippin, Cooper Market, Cranberry Pippin, Domine, Fall Jenneating, Geniton (or Ralls), Lady Washington, Mammoth Black Twig, Mann, Phoenix, Pound Sweet, Ribston Pippin, Rome, Rubicon, Red Streak, Runkelford, and Swaar. Almost without exception, trees of these varieties are limited to the older orchards. Only Rome and Mammoth Black Twig are found among the 60,000 trees of non-bearing age that are included in our records.

The limited data available indicate that trees of none of these varieties rank above the average in productivity. Pound Sweet, Cranberry Pippin, Black Gilliflower, and Blenheim grade out better than the average; Runkelford, Rome, Fall Jenneating, Cooper Market, Phoenix, Mammoth Black Twig, Swaar, Red Streak, Ribston Pippin, Geniton, and Mann have graded out rather poorly; Rubicon, and Sutton have ranked fairly high; Arkansas Black, Geniton, Lady Washington, Beitigheimer, Domine, Runkelford, Pound Sweet, Phoenix, Mammoth Black Twig, Blenheim Pippin, and Ribston Pippin have been distinctly unsatisfactory. Considering all the angles from which a variety must be judged, not one of the above varieties rises above mediocrity. Most of them fall far below it. They have been tried and found wanting.

Some of the Newer Varieties

Stayman—In the strict sense of the term, Stayman or Stayman Winesap is by no means a new variety but it has not been long under trial in Michigan. The success that has attended its culture in a number of other sections is probably the principal factor that has stimulated its planting here. Like the other members of the group to which it belongs—Winesap, Arkansas Black, Mammoth Black Twig, Paragon—it is more suited to regions with longer and hotter summers than characterize the apple raising districts of Michigan.

In occasional seasons, it may be expected to reach a high degree of perfection here; in the average season it is likely to be undercolored and somewhat lacking in size and quality. Any demand which it may be considered as especially well suited to meet can probably be filled equally satisfactorily and with greater profit to the grower by Canada Red. The tree is only a little less subject to winter injury at the

crown and crotch than Grimes. Its further planting is not recommended.

Opalescent—Apparently a large number of trees of this variety were planted in Michigan shortly after its introduction. Planting then dropped off and comparatively few trees are found in the non-bearing orchards. The tree is a good grower and apparently productive. The records show that it grades out exceptionally well and that it sells for good prices. It appears to be promising for further trial as a high class dessert variety between the season of Wealthy and Jonathan. It probably holds out greater promise for local market than for distant carlot shipments. Experience with it, however, is too limited to recommend its general planting.

King David—King David is not exactly a new variety, though few trees over 15 years of age are to be found in Michigan. Since it is in season with Jonathan and must be regarded as a competitor of that variety it may be compared with it. The tree is apparently distinctly less productive, the fruit grades out much poorer and during the past five years has sold at an average price barely exceeding two thirds that of Jonathan. Though considerably planted it may be unhesitatingly condemned for commercial culture in Michigan and the existing trees should be topworked while still young.

Golden Delicious—Golden Delicious has been offered to the trade for only a few years. It has, however, been extensively advertised and considerably planted. It comes into bearing young. Later producing qualities are not known. The fruit is of high quality but there is reason to believe that the same difficulty will be found in marketing it to advantage as with Grimes. Present observations would lead to the belief that it is subject to the same form of winter injury at the crown as that variety. Growers will do well in going slow in planting this variety before it has been thoroughly tested.

Cortland—Though introduced to the trade only recently this variety has received much publicity and evoked considerable interest in this state. It is the result of a cross between McIntosh and Ben Davis and is supposed to combine the desirable characteristics of those two varieties. Preliminary trials indicate clearly that as grown in Michigan it is inferior in quality and in no sense a substitute for McIntosh; it cannot be considered a late season variety of the McIntosh type. Whatever it may do when grown elsewhere, it is not suited to Michigan conditions.

Red Sports or Strains—Recently considerable publicity has been given to the discovery and introduction of solid red colored sports or strains of certain standard varieties that normally bear striped or striped and splashed fruit. Among the varieties whose red sports are now available on the market are: Duchess, Rome, Twenty Ounce, Northern Spy and Delicious. For the most part these bud strains are of such recent introduction that no records are available as to their orchard performances. So far as can be seen, however, they differ from the parent varieties only in color and the presumption is that they will prove similar in their tree characteristics. Planting of these improved strains in place of the parent forms would seem to be in line with good practice.

The Variety Situation Summarized

What are the characteristics that a variety must possess to be profitable and the lack of which makes it a liability? The orchard, packing house, and sales records that have been obtained make possible a fairly definite answer to this question, at least in so far as the Michigan producer for shipment is concerned.

First, last and all the time: the tree must be a heavy producer. If it comes into bearing young, so much the better, but heavy production in the mature tree is of the utmost importance. This should be self evident but actually it is generally given second consideration and the evidence indicates that many growers practically ignore it. No matter what a variety sells for per bushel there must be bushels to sell if there are to be returns, to say nothing of profits. Furthermore as the yield per tree or per acre increases the production cost per bushel decreases and the margin of profit automatically widens.

In the second place, the "tree run" fruit should grade out well as it goes over the sorting table. The real profit lies in the A-grade fruit, for the lower grades seldom bring prices that leave much of a margin over growing, harvesting and handling costs.

Third, the fruit should sell at a good price. This is obvious and is the factor that practically all sales agents and a good share of the growers think of first and sometimes exclusively.

It has been said that variety lists are being increasingly determined in the market. Within certain limits, this is true. The wholesaler and retailer will buy and pay a good price for what he can sell and sell readily—not what some producer may want to unload on him. Growers should plant and produce those varieties, and only those varieties, for which the demand is good. There are enough good varieties from which to choose. If growers have trees of varieties that are generally a drug on the market, the practicability of destroying them or top working to better sorts should be carefully considered.

For the most part "quality" varieties only are wanted. The only important exceptions found in the course of this study are Yellow Transparent and Duchess, early sorts used exclusively for culinary purposes. Other inferior quality varieties such as Ben Davis and Stark are still important factors in the market but they are on the decline.

Applying these general variety specifications to Michigan's variety list and her climatic, soil and market conditions the following conclusions may be drawn from the data that have been obtained.

Of the summer varieties, Yellow Transparent, Duchess, Chenango, and Wealthy are the most profitable. The first two are already heavily planted and further planting is not warranted. Indeed there is good reason for topworking many Duchess orchards, particularly in the northern part of the state, to later varieties. The season of Wealthy is later and longer but future plantings of this variety should be made conservatively, probably principally with the idea of supplying local markets. There is room for a limited planting of Chenango for roadside or other special local markets. Its general planting for carlot shipments is not warranted.

Of the late fall and winter varieties, Snow, McIntosh, Jonathan, and Grimes head the list. The first two varieties are especially well suited

to the more northern, the last two to the more southern producing areas; though Snow and McIntosh will prove profitable to the Indiana-Ohio line. These varieties are equally well suited to carlot shipments and local markets. Delicious has not proven productive but there is good reason to believe that this condition can be remedied. However, the indications are that it will be relatively more profitable for local than for general markets and future planting should be done accordingly.

Among the midwinter sorts, Rhode Island Greening and Northern Spy stand out prominently. If a third variety of this season is required Baldwin must be considered a contender for this place.

For late winter-early spring demand Canada Red should receive first consideration.

Many other varieties are proving profitable. On the average they are not so profitable as those that have just been named. It is, however, doubtful if growers who have trees of such varieties as Wagener, Winter Banana, Opalescent, Northwestern Greening, Golden Russet, Ben Davis, Stark, Alexander, and Wolf River can afford to graft them over unless they are still young.

THE INDIVIDUAL FACTOR IN ORCHARD MANAGEMENT

Throughout this discussion variety has been compared with variety and individual sorts have been rated principally on the records they have made in the orchards of the average grower. However, many references have been made to the fact that varieties with a very ordinary or even rather poor average record have done exceedingly well in certain individual orchards. Indeed, these exceptional cases are often fully as significant as average performance. Attention has also been directed to almost startlingly low average yield records for all varieties in all orchards. Contrasting sharply with these averages are some exceptional performance records. It is believed that some of these high lights and shadows furnish a view of the orchard business more important than any of the facts thus far brought out.

The Factors Responsible for High and Low Grades

Table 10 brings together condensed production records of 47 orchards, 20 being those whose entire crop for the five-year period has been 60 per cent or more A-grade, 27 being those whose crops for the same period has been 35 per cent or less A-grade. Careful check of the records for the individual orchards of these two groups indicate that they are of about the same average size, their varietal composition is practically the same, the trees average about the same in age and that the differences in average yield per tree are negligible. In other words the difference between the two groups is one of soil, location, or management methods. If the average net returns per bushel for which the fruit of the several grades sold during the five-year period (Table 4) are used, it appears that the first group of growers actually received 74

cents per bushel for their entire "tree run" product delivered at the community packing house platform; the second group of growers received 52 cents per bushel for their "tree run" product. This is a difference of 42 per cent. Assuming an average yield of five bushels per tree and a stand of 35 trees to the acre this would make a difference in actual returns to the grower of \$38.50 per acre each year.

Naturally, the question arises as to the factor or factors of soil, site, or management that are responsible for these differences in grade. In order to identify or determine these factors so far as possible, most of the orchards listed in Table 10 were revisited in the spring of 1926 for detail observation. Plainly, location or site had nothing to do with grade, unless perhaps it might be said that indirectly poor locations contribute toward high grade through reducing the size of crops during seasons of general frost damage.

Furthermore, the difference between the high grading and the low grading orchards could not be attributed to differences in number of spray applications. Doubtless, there were differences in the thoroughness and timeliness of spray applications but without exception all of these orchards received from five to seven applications per season. It was noted, however, that several of those orchards whose product had graded out rather poorly were somewhat under-equipped for effective pest control. This probably has meant that certain of their spray applications have not been as timely as is desirable.

On the whole, however, low grades have not been due principally to insect and fungus blemishes. Further, there were apparently no marked differences in tillage practices between the two groups of orchards. Some of the high-grading orchards were under a clean cultivation system of management, some were in sod. The same statements hold for the low-grading orchards.

The one thing that stands out so clearly and distinctly that there is no possible chance of missing it or of misinterpretation is that the trees in the high-grading orchards were vigorous; those in the low-grading orchards lacked vigor. In some instances the trees were vigorous because they were young; older trees in the same orchards were less vigorous and produced poorer grade fruit. In most cases, however, vigor was determined largely by soil and soil treatment. Where the soil was strong, fertile, and deep, or where it was deep and light but natural fertility was supplemented by very liberal use of farm manure and nitrogenous fertilizers, the trees were reasonably vigorous and produced good fruit. Where the soil was shallow or light and infertile and the trees obviously underfed, the grade was poor. This is true because under existing conditions in most commercial apple orchards in Michigan grade is determined more by size than by blemishes.

Contrary to what was expected, no close relation was found between grade of fruit and pruning. Orchard No. 70 would be generally considered well pruned. It has yielded high-grade fruit. Many others in the high-grading group have been well pruned. On the other hand, many have not. Orchard No. 14 would be called one of the poorest in the entire group from the standpoint of pruning; it is practically an unpruned orchard. Yet, 62 per cent of the fruit it produced during the past five years has been A-grade. Orchard No. 25 would be called

one of the best pruned orchards of its age in the state. In spite of this, only 24 per cent of its fruit has met the A-grade specifications. This poor record is no more to be attributed to its good pruning than is the good record of Orchard No. 25 to be attributed to its poor pruning. Its soil is of such a character and soil management has been such that the trees were weak and the fruit small.

Assuming that the orchard will be well sprayed, the grower's principal insurance against low grade lies in the selection of a reasonably fertile, deep, well drained, and well watered soil and suitable soil management methods. Other things equal, grades are determined by soil and soil treatment and by spraying, not by site, exposure, or pruning saw.

The Factors Responsible for High and Low Yields

Tables 11 and 12 present condensed records for some of the most and some of the least productive orchards covered by this survey. The detailed records of these individual orchards show that the varieties were about the same in the two groups and the tables themselves show that their fruit grades out about the same. The only significant difference between them, as shown by the records, is in yield. Average yields for the two groups are approximately as four to one and average returns per tree and per acre are of corresponding magnitude.

Exact data on production costs are not available, and a discussion of them is not attempted here. To any one well informed about the apple business, however, it is obvious that the orchards of this low yielding group are not paying for overhead, maintenance, and harvesting costs. They are liabilities rather than assets. The rest of the farm must contribute rather liberally to their support. On the other hand, it is equally obvious that the orchards of the other group are netting their owners a good profit.

As in the case of grades, there are certain factors associated with high yields and certain others that apparently are mainly responsible for low yields. Chief among these is location or site. As things now stand, the grower's greatest hazard is damage from spring frosts. Their occurrence is irregular but certain. Against them he has but one insurance—the choice of a favorable location. (Frost protection through the use of orchard heaters has thus far not proved practicable under Michigan conditions). Many orchards are so located that one, two, or three years out of ten the crop is entirely destroyed by frost and even more frequently damaged.

Orchard No. 73 in this study is on good soil, has had excellent care; the trees could be described as being in the best of condition. It is owned and managed by a man recognized as one of the best growers in the state. Yet 200 35-year old trees of one variety averaged only one bushel each per year, and another 100 45-50 year old trees averaged only a bushel and a half each during this five-year period. The explanation lies in reduction of crop by frost.

Part of the trees in orchard No. 9 are well located, part are in a draw or depression. Those on the lower ground have repeatedly had their blossoms damaged by frost when those better situated escaped injury. These are typical instances of a condition that explains much of the low yield.

On the other hand, ideal sites do not guarantee heavy yield. Orchard No. 85 is located on a high bluff overlooking Lake Michigan. Few sites in the state possess better natural advantages from the standpoint of freedom from frost. It has been under capable management. Yet the five-year annual average yield of its 242 38-year old trees has been less than three bushels per tree. It contains 75 38-year old Baldwins that during this entire period yielded only 250 bushels of fruit. The explanation lies in its shallow infertile soil, for the trees have been well pruned and sprayed. Though 38 years old, the trees have tops no larger than they should be at 15. It is a case of stunting, of dwarfing. Many similar instances might be cited.



Looking down between two tree rows in orchard No. 85. These trees, 45-50 years old, have averaged only a bushel and a half apiece each year. The site is excellent but the soil is very poor. Note how small the tops are for trees of their age. It is doubtful if such an orchard can be made to yield a profit under any system of management.

As with grades, there is evident no relation between yield and kind or amount of pruning. Some of the most productive orchards have been well pruned, others have been almost totally neglected in this respect. Some would describe orchard No. 85, whose record has just been cited, as ideal from the standpoint of pruning; others might consider it overpruned. Its low yield has not been occasioned by its pruning; there is no reason to believe that its pruning resulted in better yields than would have been obtained without pruning. These statements are not made to encourage growers to do more or to do less pruning. They simply report the facts and serve to emphasize the outstanding things brought out in this study—i. e. assuming that the trees are well sprayed, yields are very largely determined by site and soil.

Table 10.—Records of individual growers whose grading records have been superior or inferior.

Grower's number	Total yield, bu.	Percent A-grade	Percent B-grade	Percent C-grade	Percent canner	Percent unclassified	Percent bulk
20 growers producing high grade fruit:							
13.....	2,659	74	13	9	0	0	4
14.....	1,044	62	24	11	0	0	3
18.....	9,013	64	19	10	0	0	7
23.....	5,046	75	5	11	0	0	9
24.....	1,562	69	8	22	0	0	1
59.....	10,224	63	19	18	0	0	0
64.....	2,211	69	20	11	0	0	0
65.....	6,730	60	24	14	2	0	0
66.....	5,547	74	14	10	2	0	0
67.....	3,977	62	20	16	2	0	0
69.....	4,454	67	17	12	2	0	2
70.....	12,995	70	17	10	1	0	2
82.....	2,596	61	15	20	1	3	0
83.....	17,528	64	19	14	0	1	2
87.....	6,267	67	18	10	2	1	2
97.....	15,715	61	19	14	2	2	2
103.....	1,144	62	11	4	0	0	23
112.....	36,402	62	18	3	9	3	5
115.....	8,640	72	10	13	4	3	8
132.....	850	70	4	5	2	0	19
Total.....	154,604	1,328	314	237	29	13	89
Average.....	7,730	66	16	12	1	1	4
Average returns per bushel for tree-run fruit.....		.60	.09	.02	.01	.00	.02
27 growers producing low grade fruit:							
25.....	12,614	24	7	10	0	0	59
28.....	13,819	30	30	28	3	2	7
29.....	10,982	22	32	41	3	0	2
30.....	10,414	30	27	38	2	2	1
32.....	23,150	32	28	25	5	3	7
36.....	7,377	29	37	30	3	1	0
39.....	4,375	28	30	35	3	1	3
45.....	2,412	15	14	47	1	4	19
48.....	4,156	27	15	31	12	9	6
53.....	7,108	27	15	35	3	9	11
55.....	7,087	19	15	51	0	9	6
57.....	1,267	15	16	43	0	16	10
80.....	4,056	34	18	39	3	0	6
81.....	9,948	30	17	46	1	2	4
90.....	7,352	28	19	47	3	1	2
91.....	1,732	29	24	39	0	3	5
94.....	1,314	24	12	58	4	2	0
101.....	763	20	12	24	0	0	44
107.....	755	27	6	11	0	0	56
111.....	2,873	27	8	7	0	0	58
114.....	622	34	25	16	0	11	14
118.....	5,120	32	12	26	21	3	6
120.....	1,436	27	13	41	6	0	13
122.....	2,740	31	13	29	26	0	1
126.....	7,760	34	13	35	10	3	5
134.....	865	31	0	18	0	0	51
135.....	908	15	0	41	0	0	44
Total.....	153,005	721	458	891	109	81	446
Average.....	5,675	27	17	33	4	3	16
Average return per bushel for tree-run fruit.....		.24	.10	.06	.02	.01	.09

Table 11.—Average yields in individual orchards.

Grower's number	Grade rating	No. 13-20 yr. old trees	Ave. yield per tree	Total yield	No 21-35 yr. old trees	Ave. yield per tree	Total yield	No. trees over 35 yrs.	Ave. yield per tree	Total yield
High yielding orchards:										
13.....	74	121	4.7	558						
17.....	44	219	5.9	1,293						948
44.....	37	508	4.1	2,084						3,820
52.....	45	70	4.3	301	24	8.5	204	158	6.0	449
51.....	39	14	4.8	67	48	8.2	394	42	10.7	4,560
58.....	45	24	14.4	345				518	8.8	
59.....					394	5.2	2,048			
69.....	67	45	2.4	108	5	3.6	18	180	10.7	1,926
70.....	70	60	4.2	252	148	5.68	841	248	12.6	3,124
74.....	45				289	12.2	3,525	55	12.1	665
95.....	51				300	9.3	2,790			
96.....										
Total.....		961		5,008	1,204		9,820	1,655		15,492
Weighted average.....	52		5.2			5.9			9.4	
Low yielding orchards:										
5.....	39	43	1.8	77	103	1.5	154	72	2.3	165
10.....	44	1,106	1.1	1,117				315	2.5	789
18.....	64	60	2.2	132	745	2.1	1,565			
24.....	69	366	0.6	220						
41.....	36	275	1.3	357	140	2.1	294			
73.....	44	900	1.73	1,557	210	1.0	210	109	1.6	174
75.....	39	250	1.23	307				774	2.74	2,120
85.....	47							307	2.9	890
87.....	67	2,032	0.8	1,625				24	6.7	126
91.....	29	39	2.0	78				119	2.1	250
Total.....		5,071		5,470	1,198		2,213	1,720		4,514
Weighted average.....	48		1.1			1.8			2.6	

Table 12.—Influence of yields in individual orchards on returns per acre.

	High yielding orchards			Low yielding orchards		
	13-20 yrs.	21-35 yrs.	Over 35 yrs.	13-20 yrs.	21-35 yrs.	Over 35 yrs.
Average yield per acre (bu.).....	182	206	309	38	63	91
Average income per acre.....	\$94 60	\$107 00	\$160 50	\$19 75	\$32 75	\$47 30

EFFICIENCY IN PRODUCTION

It is almost needless to say that the ideal combination for the individual enterprise is that of high yield and high grade. Such a combination is illustrated by the orchard that is listed as No. 70 in these records. For the entire five-year period its fruit has averaged 70 per cent A-grade and 17 per cent B-grade. The average net returns per bushel for the unpacked tree-run fruit has been 76 cents. Its 60 13-20 year old trees have averaged 4.2 bushels per tree per year, its 148 21-35 year old trees 5.68 bushels and its 248 trees over 35 years of age 12.1 bushels. This means an average annual cash return to the grower of \$3.19, \$4.32 and \$9.57 per tree from trees of the different ages, or acre averages of \$111.50, \$151.25 and \$334.50 respectively.

A short distance away is the orchard of another grower, No. 75 in this record, containing trees of the same varieties and of about the same average age. Only 39 per cent of his product could be packed out in the A-grade; 20 per cent packed out B-grade; 23 per cent went into the cider barrel. The "tree run" average brought just 50 cents per bushel. His 13-20 year old trees yielded him an annual income of 61 cents per tree, \$21.30 per acre; his trees over 40 years old an income of \$1.37 per tree, \$48.00 per acre. These differences are not varietal and they were not due to differences in price. Both sold at the same figures and employed the same marketing machinery.

The differences are individual, personal. They far exceed the differences between varieties due to price or yield or all three put together. They spell the difference between success and failure. They lend weight to the statement that after all the greatest factor in orchard management, in the success of the orchard enterprise, is the personal factor. No variety or combinations of varieties would make orchard No. 75, located and managed as it is, profitable. Grower No. 70 could make money with Rambo or Red Astrachan, with his management methods and his location.

This is far from saying that the variety question is not important or that good growers should plant second rate sorts. Good growers will not do so; average and below the average growers cannot afford to. It is saying, however, that in the last analysis the problem of the producer is production and that profits are determined by his efficiency in production.

Efficiency in production is a product of three main factors: (1) the place where the trees are to grow, by which is meant site and soil, (2) the choice of the right varieties and (3) care of soil and trees. No choice of varieties and no amount of attention devoted to soil management or to care of the trees themselves will compensate for a poor site and poor soil. Good site and good soil may be written in bold face type as the first and the foremost requirements of a successful orchard enterprise. Alone they do not guarantee success but success is not possible without them. Enough evidence has been presented in this paper to convince the most skeptical of the importance of choosing

good varieties. Proper care of the bearing apple orchard is largely a matter of maintaining soil fertility, controlling its water supply and of thorough timely spraying.

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SUMMARY

In General:

The price for A-grade apples has averaged, for the last five years, about \$1.25 per bushel.

There is no reason to expect a material rise in this average, except as the lower priced varieties are eliminated.

The business of apple production must be organized on a basis of low or moderate prices.

However:

Some varieties consistently yield heavily.

Some varieties consistently yield poorly.

Some varieties grade out nearly two thirds A.

Some varieties grade out barely one third A.

Furthermore:

A-grade apples bring over a third more than B-grade and nearly five times as much as C-grade.

At the same time:

Some orchards produce 75 per cent A-grade apples.

Some orchards produce under 25 per cent A-grade apples.

Some mature orchards average less than three bushels per tree annually.

Some mature orchards average more than 12 bushels per tree annually.

Moreover:

Grade is determined primarily by size which is controllable and secondarily by blemishes which are avoidable.

Size is determined chiefly by soil and soil management methods.

Blemishes are due largely to poor spraying and careless handling.

Yield is determined primarily by location and secondarily by soil.

Finally:

Profits depend primarily on yield and secondarily on price, which means:

Site, soil, grades, variety, and price, in the order named, are the most important factors in apple production.