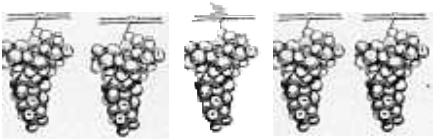
for juice purposes. Others have been tried but have failed to meet processor's requirements. Fredonia has shown several faults, lower yields, a definite tendency for the berries to shell, and poor juice quality.

Sheridan is too late and, in most seasons, fails to mature. Campbell's Early, or Island Belle, which has grown mainly west of the mountains, doesn't produce well and processors do not want it. Van Buren, a new variety, shows promise, but is as yet untested.

A few growers are producing *Vinifera* grapes but growing conditions for wine grapes are not the best with both yields and quality of fruit being below California standards. Consequently, expansion in Washington is limited to juice grapes and to the one variety, Concord.



Why Varieties of Fruits and Vegetables Have Failed

By Neil E. Stevens,
University of Illinois

Competition between varieties of cultivated plants must be as old as agriculture. The continual selection of varieties for planting parallels in many respects the much more widely recognized natural selection among wild plants and animals. Even natural selection in the strictest sense plays a basic part among cultivated plants since only those individuals can be reproduced in any given crop season which in the last (or some recent) season were able to produce adequate seeds or other reproductive structures.

Above this level there must occur in all but the most primitive agricultures a continual, perhaps more or less unconscious, selection of those plants (eventually to be recognized as varieties) which proved most productive, most easily propagated, most attractive, or otherwise desirable. For many years the choice of the most suitable varieties of cultivated plants for any locality has been a recognized problem. Discussions regarding the comparisons of varieties had a prominent place in the meetings of the early horticultural societies in this country. With the development of formal breeding programs, the competition has become more intense, with the possible result that the commercial life of varieties will tend to become shorter.

Only a Few Varieties Important Commercially

The results of this competition are evident in the fact that while literally hundreds of varieties of some fruits and

The rating scale used in this study was published by M. J. Dorsey and N. E. Stevens of the University of Illinois. An appreciable number of these scales are still available. The Authors will be glad to send copies to interested persons as long as the supply lasts.

Most of the computations on which these results were based were made by Phyllis Olmstead Conover.

vegetables are introduced and many of these persist for some time, the bulk of the commercial crop at any one period is produced by relatively few varieties. One concrete measure of this well known fact, suggested by Mr. Donald Reddick, is a comparison between the varieties known to have been tried in New York state and those which have actually produced the crops. Beach[1], in his volumes "The Apples of New York" lists 334 winter varieties and 301 early and fall varieties, a total of 635. A careful reading of the preface to these volumes leads inescapably to the conclusion that all the varieties there listed had been actually tried in New York state, at least experimentally. The implication is clear (p. viii) that a considerable number of varieties known to exist were not included in the list. Yet during the time this work was being carried on, more specifically in the years 1896 and 1904, (p. 17) two varieties, Baldwin and Rhode Island Greening supplied "at least two-thirds of the apples grown for market in New York."

In 1942-43[2] McIntosh made up 58.7 per cent of the commercial apple crop of New England and Baldwin 17 per cent. These two varieties plus Rhode Island Greening comprise 56.6 per cent of the commercial crop of New York. The next most important variety made up less than 5 per cent of the crop of these two sections.

The same thing is true of sweet corn. In "Vegetables of New York"[3] there are listed 252 varieties of sweet corn actually grown in the state during the years 1928-1933. Yet during the year 1944 Golden Bantam, and the hybrids which are very similar to it in quality, made up 96 per cent of all the corn canned commercially in New England, and the entire canning crop of New York.

As is illustrated by the history of the apples in New York State, one variety may be predominant at one period and another some years later. The rate of "turnover" would be expected to vary with the nature of the crop and to some extent with the intensity of success of current breeding programs. The commercial success or failure of different varieties may obviously be due to quite different qualities. Certain varieties of fruit seem to have maintained their position for considerable periods because they were sufficiently firm to be shipped long distances. Others have been wiped out by marked susceptibility to a disease for which no control was available.

The question as to the specific qualities which *most often* cause varieties to fail is one on which I have made several fruitless attempts to secure information. One of the most expensive of these attempts was a survey of the annual reports of all the State Experiment Stations over a period of years. A quite different method of approach was suggested in a brief paper by my colleague, Dr. Potthoff[4],

[1] Beach, S. A. The Apples of New York. Vol. 1:409, 1905. Vo. 2:360, 1905.

[2] Apple Production by Varieties, 1942-43. Mimeographed publication: U. S. Dept. of Agric., Bureau of Agric. Economics, Crop Reporting Board.

[3] Tapley, W. T., W. D. Enzie, G. P. Van Esteltine. Vegetables of New York. Report of the New York State Agricultural Experiment Station for the year ending June 30, 1934.

[4] E. F. Potthoff, Comment on "What it Takes to Teach the Plant Sciences". Journal of the Am. Soc. of Agr. 36: 712-713. 1944.

namely the use of a "rating scale." This in the hands of experienced judges might at least be expected to indicate the degree to which a given variety approached each person's own standard of perfection in a number of important characters.

A Rating Scale For Fruits And Vegetables

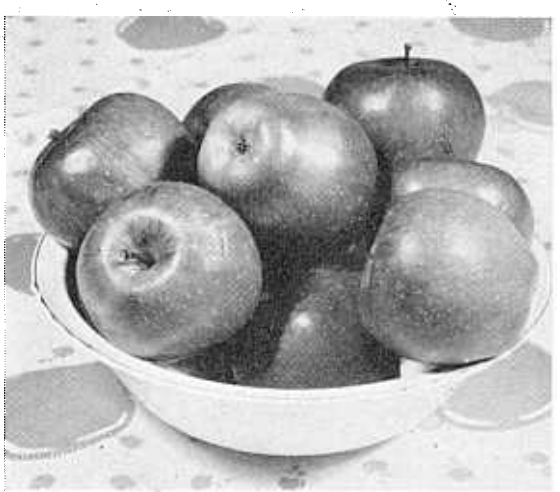
Several conferences of horticulturalists and plant pathologists resulted in the selection of eleven qualities, each of which seemed of obvious importance in the commercial success of varieties of fruits and vegetables. These were arranged at random on the rating scale as follows: (1) Ease of propagation, (2) Insect resistance, (3) Adaptability to a wide range, (4) Yield, (5) Disease resistance, (6) Eating quality (raw or processes), (7) Consumer appeal (i.e. appearance), (8) Drought resistance, (9) Keeping quality (including cold storage), (10) Handling quality (i.e. ability to stand picking and shipping), (11) Cold resistance. No attempt was made to appraise the relative importance of the qualities named. Moreover, the explanatory paragraph at the head of the rating sheet included the sentence "Not all the significant qualities are here listed and you are at liberty to add one or more if you desire". As a matter of fact, however, few correspondents took occasion to make such additions.

This scale was sent to a number of plant pathologists in the United States and to all County Agents in New York and New England. Each was requested to list as objectively as possible some variety of fruit or vegetable familiar to him. It was further suggested that, when practicable, two varieties be rated, one which had been commercially successful over a considerable period and another which had failed. Obviously no absolute criteria could be set up for the guidance for those who made the ratings. All anyone could do would be to indicate how closely a given variety approximated his own ideal. The response was generous. However, such a blanket invitation naturally resulted in the rating of a large number of crops.

The first point to be considered was whether the scale was usable. Were the judgments recorded on it comparable between different groups of observers. Perhaps such a question can never be fully answered but the results for the most frequently rated varieties are certainly suggestive.

Rating of McIntosh Apple

Figure 1 gives the ratings of McIntosh Apple by seventeen professional plant pathologists as compared with the ratings



Delicious apples, a favorite with consumers throughout the United States.

given by twenty-six county agents in New York and New England. Such agreement can hardly be accidental. Both groups rate the McIntosh very high in eating quality and consumer appeal. The qualities receiving the next highest scores are yield and cold resistance. As noted above McIntosh is the most important commercial apple in New York and New England. Would any competent observer question that its preeminent position at the present time is due to the possession of the very qualities rated highest by those who used this scale? Would any competent observer question either that this preeminent position is maintained in spite of extreme susceptibility to disease, particularly apple scab, and poor handling quality.

It would appear that the use of this

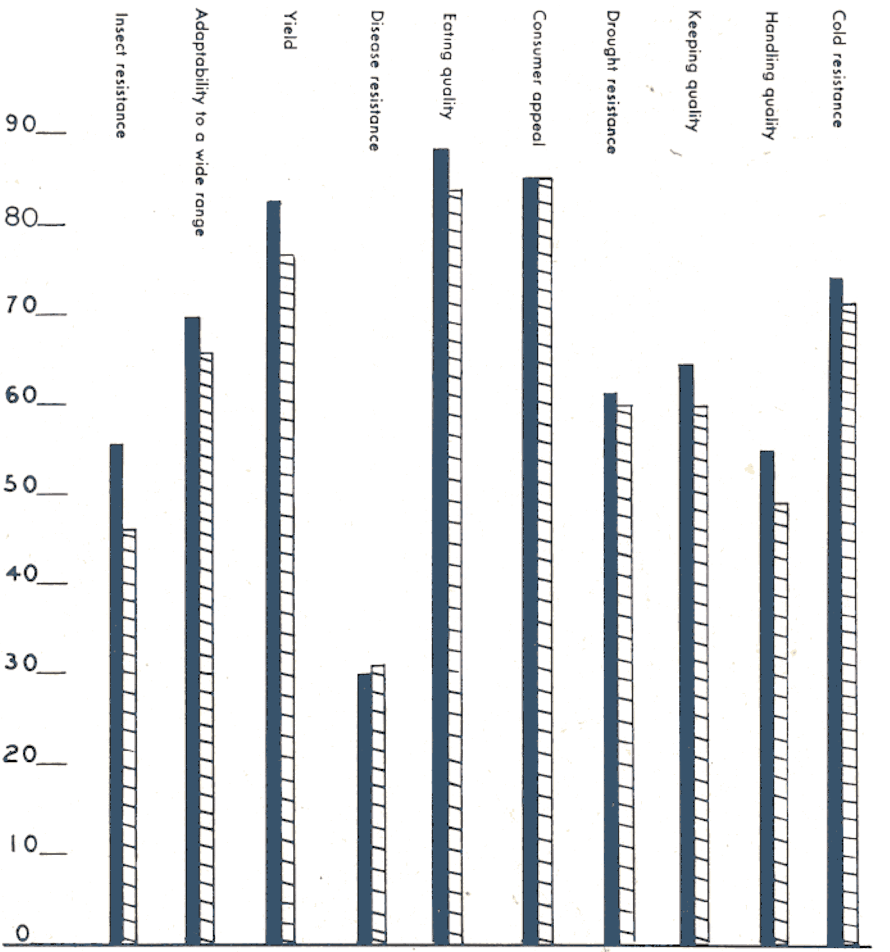


Figure 1. Average ratings of the McIntosh apple. Solid bars represent the judgment of 17 plant pathologists, cross hatch 26 county agents.

scale by experienced observers does give a fairly accurate record of their opinions as derived from experience.

Rating of Baldwin, Cortland, And Delicious

To further check the usefulness of the rating scale as a means of appraising various qualities of commercial varieties of fruits and vegetables, it seemed worth while to compare the ratings assigned to McIntosh by the County Agents with those assigned to other important apple varieties in the same area. The results of such a comparison of Baldwin, Cortland, and Delicious are given in Figure 2. In this figure the ratings given McIntosh (shown in Fig. 1) are considered as zero. The length of the bars above this zero line indicate the amount by which the variety to be compared was scored as superior to McIntosh in those particular qualities. The length of the bars below the line indicates the amount by which this particular variety was scored as inferior to McIntosh.

Of particular interest, of course, is the variety Baldwin formerly preeminent and still second in importance in this area. As the figure clearly indicates Baldwin was rated as markedly better than McIntosh in disease resistance and handling quality, both of which are obviously in accord with the facts. Baldwin is also rated nearly fifteen points higher in keeping quality. On the other hand Baldwin is rated much lower than McIntosh in yield, eating quality, consumer appeal and cold resistance. None of these ratings is likely to be questioned by any one familiar with the varieties or who remembers the disastrous effects on Baldwin trees of the severe winter of 1933-34.

So far as this sort of evidence may be considered valid, this scale does then seem

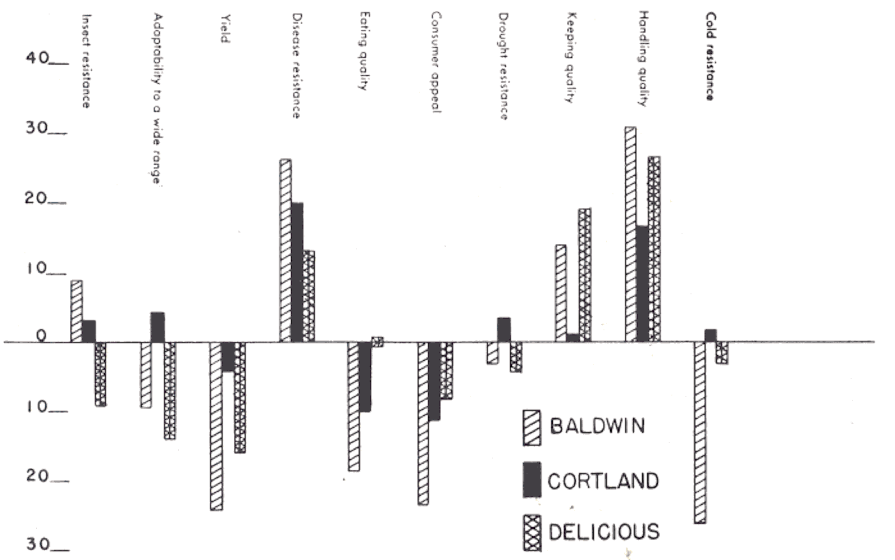


Figure 2. Average ratings by county agents of Baldwin, Cortland, and Delicious apples compared with McIntosh. Zero is average for McIntosh, see Figure 1.

to furnish a means of correlating opinions regarding the various qualities of these apple varieties. This comparison of Baldwin and McIntosh obviously raises questions as to the degree to which the qualities that made Baldwin supreme in an earlier generation have declined in importance with improved spraying schedules and handling methods.

The major purpose of this paper is to illustrate what can be done by the use of this rating scale and if possible to interest members of the American Pomological Society in its further use. This method was used in the evaluation of several vegetable crops in addition to the apples which have already been discussed. Space does not permit a detailed presentation of these results but they are included in the general summary which follows in the next section of this report.

Why Varieties Have Failed

The commercial success of a variety is, of course, determined by its strength or weakness *relative* to other varieties. Obvious great weakness in almost any one of the characteristics listed in the rating scale might cause a selection to be discarded in breeding test plots. Too great weakness in any one critical factor may cause, (indeed often has caused) the failure of a variety already in commercial production. On the other hand a very considerable degree of weakness in some one characteristic may be more than overbalanced by great strength in other respects.

The difficult question which is being

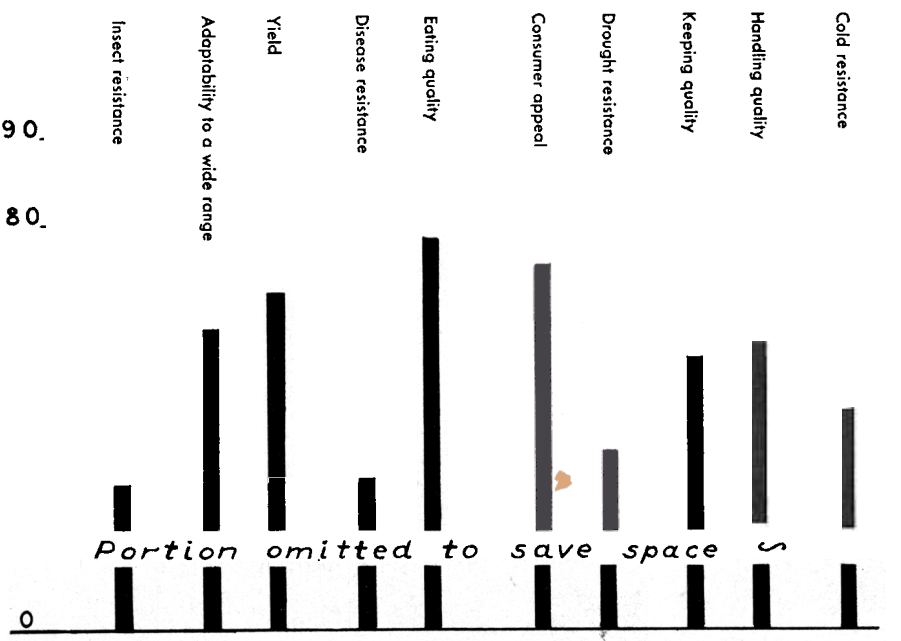


Figure 3. Average scores of 63 varieties of fruits and vegetables listed as successful by plant pathologists.

attacked here is, which weaknesses have been *most often* responsible for the failure of commercial varieties of fruits and vegetables. Whether the information obtained gives an adequate answer is itself a question. It does, however, give the best answer I have thus far found. In all, sixty-three replies were received from plant pathologists in which "successful" varieties and failures were paired on the same rating scale. They were not, of course, always of the same crop, but the results seem worth study.

Simple averages of these sixty-three scores of successful varieties are given in Figure 3. Apparently these "successful" varieties came nearer the "ideals" of the interested plant pathologists in eating quality and consumer appeal than in any other qualities. The low rating given insect and disease resistance might at first be considered a reflection of professional prejudice. It should be noted, however, that the average scores of twenty-four observers who were not plant pathologists, that is, horticulturists, entomologists, and county agents, agreed very closely with those of the pathologists. Moreover, the sixty-three failures seemed to the pathologists to fall even farther below their ideals in eating quality and consumer appeal than in any of the others. (Figure 4).

So far as the information here presented has any value, it would appear that those qualities having directly to do with attracting consumers are of prime importance in determining the commercial success of varieties of fruits and vegetables. This condition probably would hold true only in a country in which a surplus of such foods usually exists. It should also be observed that the ability of a variety to produce high yields of marketable fruit is a very important factor in determining its value on a commercial basis.

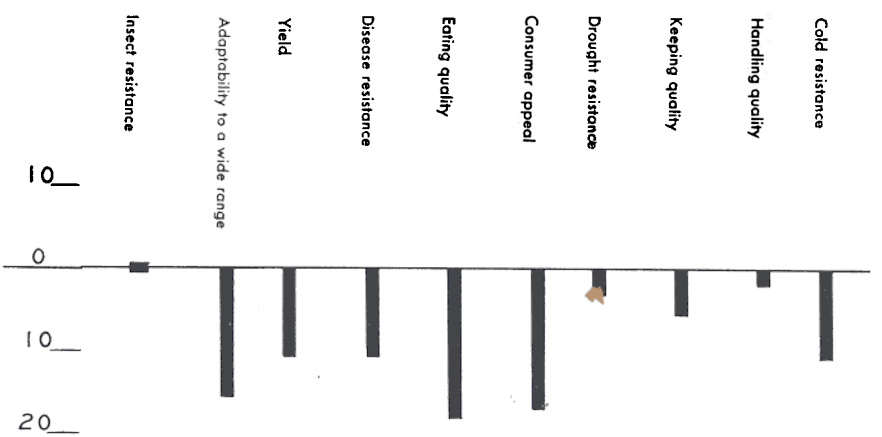


Figure 4. Average scores of 63 fruits and vegetables considered failures by the same observers as those included in Figure 3. The zero line is average of the successful varieties given in Fig. 3.