Cold storage for Iowa apples

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EXPERIMENT STATION

IOWA STATE COLLEGE
OF AGRICULTURE AND MECHANIC ARTS

HORTICULTURE AND FORESTRY SECTION

COLD STORAGE FOR IOWA GROWN APPLES

AMES, IOWA

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SUMMARY

Under present conditions of apple growing in Iowa temporary gluts are common in very many local markets from the time the earliest fruits begin to ripen till early autumn or mid autumn followed usually by an immediate shortage as soon as the early fruit passes out of season. This holds true to a constantly increasing extent from south central Iowa to the north boundary of the State. The result is low prices locally for much of the early fruit with high prices usually prevailing from mid autumn to the end of the season. Even though prices are high very often the available supply of winter apples is not first-class fruit.

The experiments demonstrate that certain desirable fall apples which are hardy enough to be grown successfully even in northern Iowa, can be held in good market condition through the winter months if handled carefully and stored quickly. This makes it possible to maintain a supply of home-grown fruit till late winter or early spring even in those parts of Iowa where practically none but early apples are now grown.

To keep well, the fruit must be (1) well grown, sound and unblemished, (2) picked when hard ripe and well colored, (3) handled carefully with no bruising or puncturing of the skin and (4) put into cold storage as quickly as possible after picking. It should be withdrawn and consumed while still in prime condition rather than held beyond the normal cold storage period of the variety.

The storing of fruit having the skin broken by the attacks of insects or fungous diseases or by bruising and delay in storing the fruit after it is picked are the most common causes of failure of apples to keep well in cold storage.

Apples designed for cold storage should be sprayed to protect them from any injury by insects or fungous diseases.

Apple scald is a trouble that is chiefly confined to certain varieties. With some varieties it can be lessened by proper handling, and by selecting hard ripe, well colored fruit and storing it quickly.

The ordinary apple barrel is a satisfactory package for the hard winter varieties. A bushel box is to be preferred for the softer, tender early sorts. Fruit is apt to be injured by wilting if stored for a very long time in a slat crate.

Wrapping the fruit with paper retards ripening, prevents
bruising and aids in preserving its bright color. It is especially desirable for the more tender early apples.

Except in seasons of very short crop it will not pay to store any but first class stock.

The large number of varieties that were tested show varying degrees of adaptability to cold storage. Some are valuable, others are nearly worthless. The individual records are shown in the variety list.
INTRODUCTION
S. A. BEACH

In trying to help the fruit growing industries to become established upon a more secure and more profitable basis in Iowa and adjacent territory, the Iowa Experiment Station is at present directing its work with fruits in two general lines of effort: (1), The securing of better varieties, and (2), the improvement of methods in the production and handling of fruit.

First, it is seeking to originate here and to find elsewhere desirable varieties which are best adapted to this region. For this purpose it is carrying on plant breeding extensively while at the same time it is continuing its long established policy of bringing in from outside sources for testing here any new or little known sorts that may appear worthy of attention. The value of extremely hardy and thrifty varieties as stocks upon which to topwork less hardy kinds of better quality is also under investigation. Thus it aims to assist in putting into the hands of Iowa fruit growers the very best material that can be found for them to work with. This is necessarily a slow process for it requires years to prove fully the merits of any new orchard variety either for fruit or for orchard stock. Only by persistent effort intelligently directed and adequately supported through a series of years can such lines of work yield results at all commensurate with the importance of the orchard interests in this rich agricultural region.

While these more permanent results are being slowly developed the Station is working for the immediate benefit of Iowa fruit growing interests by doing what it can to help the fruit growers make the most of the varieties which they now have on hand. Special attention is being given to the apple because this is by far the most important of the fruits grown in this state. This work is sub-divided into two general divisions: (1), Methods of apple growing, and (2), methods of handling apples.

1. The Station is conducting demonstration experiments in spraying apple orchards. These are showing that with good orchard management including proper attention to spraying it is not only possible but also profitable to grow
perfect apples here in Iowa and that the common practice of giving over the trees and the fruit without a struggle to the depredations of insects and diseases is very poor economy.

Other investigations which concern methods of orchard management are being inaugurated.

2. The Station is making investigations in keeping Iowa grown apples in cold storage to find out whether any of the late summer and early fall varieties can be handled profitably in this way and also to show the comparative merits of different kinds of fall and winter apples for cold storage purposes. In these experiments it has for two years had the benefit of the co-operation of the United States Department of Agriculture.

The bulletin here presented consists of an account of investigations in the cold storage of Iowa apples which were carried on in 1906-07 and 1907-08 by this Station in co-operation with the Bureau of Plant Industry of the United States Department of Agriculture. In this work the Bureau of Plant Industry was represented by H. J. Eustace, Expert in Fruit Storage, Fruit Storage and Transportation Investigations, and the Iowa Experiment Station by S. A. Beach, Station Horticulturist. V. R. Gardner assisted in carrying out the details of the operations the first season, and in June, 1907, submitted a report on this work as a thesis in partial fulfillment of the requirements for the degree of Master of Scientific Agriculture. E. E. Little, Assistant Horticulturist, assisted in the work in 1907-8.

In previous years similar experiments with apples have been conducted by the Bureau of Plant Industry* of the United States Department of Agriculture in the Eastern part of the United States, and elsewhere in the Middle West, by which some definite conclusions of commercial importance were reached, but the conditions under which apples are grown in Iowa are so unlike those of the other regions mentioned that it appeared highly desirable to continue the work under Iowa conditions. While the experiments have been conducted but two seasons, the results for these years have been so similar and so consistent with those of similar experiments made elsewhere that it appears advisable to publish them.

COLD STORAGE FOR IOWA APPLES

H. J. EUSTACE  S. A. BEACH

FEATURES OF APPLE GROWING IN IOWA.

A conspicuous feature of apple growing in Iowa is the relatively large production of early fruit as compared with that of the later fall and winter sorts. Especially is this true of the Northern two-thirds of the state where in late summer and early fall the local markets are often glutted with home grown apples and correspondingly low prices are realized. The result is that in the aggregate great quantities of this early fruit annually go to waste. It might appear at that time that over-production is more or less prevalent but such is not the case. Taking the whole season into consideration the local crop comes far short of meeting the local demand. The home supply in that region becomes practically exhausted by mid-autumn if not earlier and after that the demand for apples must be met mostly by importing the fruit from other states. The natural result is that prices advance and the amount of apples consumed is correspondingly restricted. In spite of this, many thousands of dollars worth of apples imported from other states are annually sold in the markets of Iowa.

In the more northern tiers of counties so few winter apples of any kind are grown that a full crop has practically no influence in determining local prices. Passing southward from the north line of the State both the number of varieties of desirable hardy late apples which can be successfully grown and the aggregate amount of the annual crop gradually increases till to some extent in central Iowa, and more often in southern Iowa, localities are found in which the crop of winter apples reaches considerable commercial importance.

COLD STORAGE INVESTIGATIONS NEEDED.

The apple ranks first in value among the fruit products of Iowa and under the conditions which have been briefly outlined above the question of handling Iowa grown apples in cold storage becomes one of decided economic importance. It involves problems of more than local interest. The degree to which these shall be brought to a successful solution cannot fail to have marked effect upon the immediate fu-
ture of commercial apple growing and also upon its later develop­
ment in Iowa and adjoining states.

In view of the super-abundance of early sorts and the rela­
tive scarcity of late fall and winter apples in the orchards of
Iowa, particularly in the northern half of the State, several
questions arise which are worthy of careful investigation.
Two of these which are of leading interest in this connection
are stated below.

1. The cold storage of desirable fall varieties for the pur­
pose of lengthening the season during which they can be
handled. When this can be done successfully it will be pos­
sible to distribute the crop to more distant markets, thus in­
creasing the chances for the grower to realize good prices,
and tending to decrease the apparent necessity of letting so
much good fruit go to waste.

2. The cold storage of these earlier ripening varieties, so
that they may be used to supply the home and local market
demand instead of shipping in winter apples from other states
for this purpose.

Many of the varieties which are grown in Iowa are gen­
erally unknown in the older parts of the country and among
those which are so known but very few are grown commer­
cially in those districts to any considerable extent. Some of
these varieties, however, are assuming commercial import­
ance in the horticulture of Iowa and adjacent territory. It is
therefore desirable that their adaptability for handling in cold
storage be determined as definitely as possible since this is
coming to be recognized as an important factor in the value
of any variety and particularly in its value for commercial
planting.

On the other hand, many of the varieties which are com­
mercially important in other parts of the country are known
in Iowa also and some of them are grown to a greater or less
extent in Iowa commercial orchards. Many of these have
already been tested in Department investigations in some of
the eastern states,* but the conditions of soil, climate and cul­
ture under which they grow in Iowa are quite unlike those of
the eastern apple districts referred to. It was considered
possible that these changed conditions might result in a dif­
ferent behavior of the fruit in cold storage as had been found


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to be the case in other sections, and therefore it was thought advisable to compare the results obtained with Iowa grown fruit with those obtained with the same varieties when grown in other localities.

**THE RELATION OF COLD STORAGE TO APPLE GROWING IN IOWA.**

When this investigation was started inquiry was made to learn the status of the cold storage establishments in Iowa so far as the fruit business was concerned. It was found that there were at that time about 20 cold storage houses in the state. Less than one-half of these were using any of their space for storing apples, the others were handling principally poultry, eggs, and dairy products.

The behavior of the fruit in cold storage was then a disputed question and one upon which the apple growers were very slow to take any risk. Almost without exception they followed the old practice of disposing of their fruit at the time it ripened for whatever price they could get or of letting it go to waste. It has now been demonstrated that many of the varieties of apples grown in Iowa can be held in storage for a reasonable length of time. Wealthy apples such as can frequently be bought during September for 25 to 35 cents a bushel have been stored and sold readily at three times these prices in January and February.

The systematic use of cold storage for apples should have a fixed place in the practice of Iowa orchardists. The cold storage houses that have facilities for handling apples are fairly well distributed over the state. Apple growers would do well to store the crop or part of it with as great care and regularity as is now done in parts of western New York where immense quantities of apples are thus handled every year, and in other progressive apple growing districts of the country where the value of cold storage is gaining practical recognition. Doubtless the day will come when desirable hardy varieties of winter apples will be produced in northern Iowa to as great an extent as Wealthy, Northwestern Greening, Oldenburg (Duchess) and Patten now are, and perhaps even to a greater extent. But that time is not now, and till it comes it seems good economy to make the most possible out of the orchards which are already in bearing, at the same time establishing so far as possible orchards of better or later ripening sorts.
Under conditions like those which now prevail, unless cold storage is resorted to, the advisability of extensive commercial planting in northern Iowa of the varieties named above is questionable.

**PLAN OF EXPERIMENTS IN APPLE STORAGE.**

The principal points covered in the apple storage experiments made during the two seasons of 1906-7 and 1907-8 are as follows:

1. The relation between the handling of the fruit during the operations of picking, packing and shipping and its behavior in cold storage.

2. Comparative tests of a number of varieties to determine their behavior and value in cold storage. So far as practicable these tests included fruit of the same variety from different sections of the State.

3. The comparative test of the influence of different styles of packages upon the keeping quality of the fruit when stored.

4. The influence of paper wrappers on the keeping qualities of fruit.

The apples for these tests were secured from orchards in various sections of the State, principally in northern, southwestern and east central Iowa. A description of each orchard accompanies the data included in the variety tests.

The fruit was stored both seasons in the cold storage house of E. B. Higley Co., Mason City, Iowa. The temperature of the room in which the fruit was held was 34 degrees Fahrenheit in the season of 1906-7 and 33 degrees Fahrenheit the following season. These readings indicate the temperature with the thermometer in the center of the room; near the floor it would probably have read a little lower.

**FACTORS INFLUENCING THE KEEPING QUALITY OF APPLES IN COLD STORAGE.**

**THE MATURITY OF THE FRUIT WHEN PICKED.**

During recent years greater attention has been given than formerly to the maturity of the fruit at the time of picking and its relation to the subsequent keeping qualities in cold storage. Formerly the importance of this matter was not realized, and large quantities of fruit were harvested and
stored before they were in the best condition for storage. To a large degree this came to be done as a result of scarcity of labor at picking time, and a desire to have as much of the fruit out of the way as possible before the rush of the shipping season occurred. This cause, however, cannot be as important in Iowa as in sections where the orchards are relatively extensive and fruit freight traffic heavy.

In previous experiments, it was thoroughly established that immature and partly colored fruit did not have as good keeping qualities as hard ripe, highly colored fruit. The flavor and texture, as well as the general attractiveness and market value, of this immature fruit did not equal that of the better colored fruit. The plan of the test was to make two pickings of the same variety in the same orchard. One lot was taken when the fruit was just mature but not well colored, another 10 days or 2 weeks later, when they were fully mature and highly colored. In one or two cases it was impracticable to make pickings at two times, and the two grades were obtained by selecting fruit in the two stages of ripeness at the one picking time.

The same conclusions were reached from tests in both seasons with Iowa apples. Hard, firm, well colored Northwestern Greening remained in prime condition a month longer than poorly colored prematurely picked fruit. With the Patten the scald was more conspicuous on the poorer colored lots. The difference was probably greater and more striking with Wealthy than with any of the other varieties, which included in addition to those mentioned, Grimes, Jonathan, Malinda and Winesap.

THE EFFECT OF DELAYING THE STORAGE OF THE FRUIT.

The growth of an apple is stopped when it is picked. After this time the ripening processes are hastened, and progress more rapidly than they do when the fruit is growing on the tree, even in the same temperature. The rapidity of this ripening increases in a high temperature, and is retarded in a low temperature. Summer and fall varieties, such as Wealthy, show the difference more conspicuously than do the late maturing and long keeping sorts like Winesap.

These points were determined in Iowa by picking and packing in the same orchard on the same day duplicate lots of Clemons, Grimes, Jonathan, Malinda, Northwestern Greening, Patten, Wealthy and Winesap. Care was taken to have
the lots of each variety uniform in ripeness and color. One lot was held in the orchard or in open shed for two weeks and then forwarded to the storage house. At all inspections of the fruit the lots stored immediately were in better condition, harder, firmer, and would last longer after removal than those that were delayed in reaching the storage house. This was more noticeable with early ripening, tender varieties like the Wealthy when the period of delay came during warm fall weather, than with the later ripening sorts like Winesap which were delayed when the weather was cool. With varieties that are subject to scald, the immediate storage tended to reduce and retard the development of that trouble to a very marked degree.

A delay between harvesting and storing is responsible for the deterioration of large quantities of fruit in commercial practice. The extent of this loss depends upon several things or a combination of them, the most common of which are the temperature during the period of delay and the condition under which the fruit is held, whether in piles in the orchard, in tight buildings where the warm air cannot pass off readily, or in transit in tight cars. It is not uncommon during a long period of delay, especially in warm weather, for fungus diseases that cause decay of the fruit to get started and develop rapidly while the fruit is warm, and not be checked entirely when placed in storage. Frequently the cold storage ware­houseman is unjustly blamed for such a condition of fruit, when upon its removal some months later many apples are found to be partly decayed.

Any method of handling the fruit that hastens the ripening after it is picked shortens the period of commercial value, no matter where the fruit is stored. Any treatment that checks the ripening prolongs the marketing period.

THE EFFECT OF WRAPPING THE FRUIT IN PAPER.

The value of wrapping the fruit in paper was tested both seasons. The comparison was made with duplicate quantities of fruit that were grown and handled in the same way. One lot was not wrapped, and with the other each apple was wrapped in unprinted newspaper. With some varieties like the Gano, Roman Stem, Salome, Winesap, and other hard, late ripening sorts, the advantage of wrapping in paper was not very apparent. But with tender varieties like the Cle­mons, Jonathan and Wealthy, a wrapper was a distinct ad-
vantage in extending the life of the fruit, preserving its natural brightness and lessening the amount of decay.

A wrapper serves to reduce the bruising that may result from poor packing or from rough handling in transportation; it retards shriveling and adds to the value of the fruit by preserving its attractive appearance. The wrappers cost about 20 cents per thousand for newspaper 9x12 inches.

THE EFFECT OF THE TYPE OF PACKAGE.

The first season a test was made of the influence of the style of package upon the keeping quality of the fruit. In all of the experiments boxes holding about 50 pounds were used, and a comparison was made between that and the ordinary apple barrel and a slat crate holding the same amount of fruit as the boxes.

Northwestern Greening, Patten and Wealthy apples from the same orchards were packed in the different packages and placed immediately in cold storage. With Northwestern Greening and Patten the difference between the different packs was not marked. The Wealthy kept in best condition in boxes. In the barrel the bruising was greater, and in the slat crate the shriveling was greater than in either barrel or box.

In connection with these tests, the rapidity of cooling of the fruit and air in the center of these different packages was determined when they were placed in cold storage.

Extra long mercurial thermometers manufactured especially for such tests were used. The temperature of the fruit was taken by inserting the bulb of a thermometer in the center of an apple in the center of the package, with its stem protruding. Another thermometer was so arranged that the bulb was in the air surrounding the fruit in the center of the package. Frequent readings were made for several days, the results of which are given in the following summary:

THE EFFECT OF CULTURAL CONDITIONS.

It was intended to make comparisons of the keeping quality of Iowa apples grown under different systems of cultivation, upon different soils and from trees of different ages, as was done in previous experiments made in the Eastern States. But it was found to be impossible to secure sufficient quan-
COOLING OF AIR AND FRUIT IN DIFFERENT STYLES OF PACKAGES IN COLD STORAGE WAREHOUSES.

<table>
<thead>
<tr>
<th>Package</th>
<th>Temperature of air in center of package</th>
<th>Temperature of fruit in center of package</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slat crate, Apples not wrapped</td>
<td>From 76 ° to 35 °F. in 1 day and 14 hours</td>
<td>From 78.5 ° to 35 °F. in 1 day and 10 hrs.</td>
</tr>
<tr>
<td>Slat crate, Apples wrapped in paper</td>
<td>From 78.5 ° to 35 °F. in 2 days and 18 hours</td>
<td>From 80 ° to 36 °F. in 2 days and 18 hrs.</td>
</tr>
<tr>
<td>Bushel box, Apples not wrapped</td>
<td>From 78 ° to 35 °F. in 2 days and 18 hours</td>
<td>From 77.5 ° to 35 °F. in 2 days and 10 hrs.</td>
</tr>
<tr>
<td>Bushel box, Apples wrapped in paper</td>
<td>From 79.5 ° to 36 °F. in 2 days and 22 hours</td>
<td>From 79 ° to 36 °F. in 2 days and 22 hrs.</td>
</tr>
<tr>
<td>Barrel, Apples not wrapped</td>
<td>From 78 ° to 38.5 °F. in 3 days and 2 hours</td>
<td>From 77.5 ° to 38.5 °F. 3 days and 2 hrs.</td>
</tr>
<tr>
<td>Barrel, Apples wrapped in paper</td>
<td>From 80 ° to 43 °F. in 3 days and 2 hours</td>
<td>From 80 ° to 43 °F. in 3 days and 2 hrs.</td>
</tr>
</tbody>
</table>

Practically all of the Iowa apple orchards are kept in sod. A few were found that had been cultivated to some extent, but primarily for some other crop, such as strawberries. Orchards upon the different soils were not found where trees of the same varieties of like age and care could be secured. Similar difficulty was experienced in an effort to secure apples for making a comparison of the keeping qualities of fruit from trees of different ages.

The effect of cultural conditions upon the keeping quality of Iowa apples should be made the subject of future investigations.

THE IMPORTANCE OF STORING GOOD FRUIT.

It is highly desirable that extra care be given to grading apples that are intended for cold storage. The low temperature of the storage warehouse will not improve the grade or condition of the fruit. Usually it will not pay to store anything but first grade stock. Low grade fruit is likely to deteriorate in storage, especially if held very long, and its value does not generally justify the extra expense of handling and storing. In seasons when the apple crop is short, it may be profitable to store second grade stock for a short time.

Every precaution should be taken to insure the most care-
ful handling of the fruit in all the operations of picking, haul-
ing and packing. Finger marks and bruises, particularly
when the skin is broken, result in discolored or decayed spots
which detract from the appearance of the fruit. These
breaks in the skin are entry ways for decay that may start be-
fore the fruit reaches the warehouse, and may not be entirely
checked in its development by cold storage temperatures.

APPLE SCALD.

A very common trouble of apples in cold storage is one
known as "scald". With some varieties when the fruit
reaches a certain period of ripeness a part of the apple turns
brown. It is a surface trouble, not extending into the flesh
of the apple, and the greatest harm is that it detracts from
the appearance of the fruit and lessens its commercial value.

The nature of the scald is not well understood though
considerable experimental work has been done upon it. It
is almost entirely confined to certain varieties. The Grimes,
Iowa Blush and Louise are very susceptible to it, while the
Allen Choice, Jonathan and Northwestern Greening are
among a group of varieties that do not seem to be affected
with it. Immature fruit "scalds" earlier and more than well
colored fully matured fruit, as also does overripe stock or
that which has been delayed between the time it was picked
and stored, especially if the weather was warm.

The least amount of scald is found if the apples are fully
matured, well colored and stored immediately after they are
picked.

TESTS OF DIFFERENT VARIETIES IN COLD STORAGE.

A large number of varieties of apples have been under ob-
servation to determine their keeping qualities and value in
cold storage. This list has included some varieties that
have been tested in the Eastern States, and the results have
been essentially the same. Several varieties that are un-
known outside of the State have been tested and something
of their behavior and value in cold storage determined.

So far as possible, all varieties were tested both seasons,
but this could not be done with all of them.

OUTLINE OF CULTURAL CONDITIONS.

The following is a summary of the orchard conditions in
which fruit used in the experiments was grown. In the
variety list which follows each sort is credited to the grower
from whom it was secured.
Antisdel, H. N., Milford, Dickinson County, Iowa, 1906: Wisconsin drift in moraine region, prairie, heavy black loam, yellow clay subsoil. Altitude 1650 feet. Trees 8 years old, not sprayed, sod culture.

Burnap, Col. W. A., Clear Lake, Cerro Gordo County, Iowa, 1906: Soil Wisconsin drift in moraine region; half mile from lake and about 100 feet above it; age of trees 11 years; not sprayed; sod culture.

Clemens, L. A., Storm Lake, Buena Vista County, Iowa, 1907: Upland prairie, Wisconsin drift in moraine region; soil mixture silt and drift. Altitude 1300 feet, trees 13 years old; old sod, not sprayed.

Deur, C. H., Missouri Valley, Harrison County, Iowa, 1906 and 1907: Soil Missouri loess; altitude (R. R.) 1010 feet; trees 9 years old, thoroughly sprayed, not cultivated, but in thin sod.

Fouts, W. H., Missouri Valley, Harrison County, Iowa, 1906 and 1907: Soil Missouri loess; altitude (R. R.) 1010 feet; age of trees about 15 years; sprayed, not cultivated, but in thin sod.

Harrington, F. O., Williamsburg, Iowa County, Iowa, 1906 and 1907: Soil strong loam, Mississippi loess; altitude (R. R.) 765 feet; age of trees 16 years; sprayed, part in old heavy sod and part in newly seeded clover sod.

Kinne, P. F., Storm Lake, Buena Vista County, Iowa, 1907: Upland prairie, Wisconsin drift in moraine region; soil mixture silt and drift; altitude 1300 feet; trees 13 years old; old sod; not sprayed.

Kyle, H. J., Bristow, Butler County, Iowa, 1907: Soil Iowan drift; black loam; trees 14 years old, well cultivated, thoroughly sprayed.

Miller, L. E., Clear Lake, Cerro Gordo County, Iowa, 1906: Soil Wisconsin drift moraine region; about one-half mile from lake and 75 feet above it; age of trees 12 years; no tillage or spraying.

Spencer, F. P., Randolph, Fremont County, Iowa, 1906 and 1907: Soil beach loam, Missouri loess; altitude about 1100 feet; age of trees 12 to 14 years; well sprayed; not cultivated.

Trigg, F. E., Rockford, Floyd County, Iowa, 1907: Soil Wisconsin drift, black loam; altitude (R. R.) 1021 feet; age of trees 8 to 10 years; sprayed but not cultivated.

Wilbur, D., Floyd, Floyd County, Iowa, 1907: Soil Wisconsin drift, black loam; altitude (R. R.) 1099 feet; age of trees 12 years; cultivated the first 10 years after which orchard was in sod and mulched with coarse manure, sprayed.

VARIETY CATALOG.

Allen, syn. Allen Choice. A handsome red winter apple of very good quality. Fruit below medium to small. Not much planted commercially on account of its size. Better known in east and east central Iowa than in any other parts of the State.

F. O. Harrington, Williamsburg, Iowa County, Iowa. Bright No. 1; picked September 25, 1906, stored September 26; firm and sound until May 7, 1907; would probably have remained in good condition longer; no scald or decay.
L. A. Clemons, Storm Lake, Buena Vista County, Iowa. Bright, No. 1; picked October 4, 1907, stored October 7; firm and sound until May 14, 1908; would probably have remained in good condition longer; no scald or decay.

Anisim. An attractive red apple, irregular in size and color. Season of Wealthy, but less desirable.

L. A. Clemons, Storm Lake, Buena Vista County, Iowa. Medium size, dull; picked October 5, 1907, stored October 7; only fair condition from December 7, 1907 to February 11, 1908; not valuable in cold storage.

Baldwin. A standard commercial variety in the eastern states. It is seldom fruiting in Iowa.

C. H. Deur, Missouri Valley, Harrison County, Iowa. Bright, uneven size; picked October 6, 1906, stored October 7; December 4, 1906, in prime condition; February 27, 1907, in fair condition, slight scald and decay.

Ben Davis. An attractive red winter apple, the standard commercial variety of the Central Mississippi Valley. Generally speaking it leads all other varieties in southern Iowa orchards. It is grown commercially to some extent in the central district of the state, but is not hardy enough to be recommended for general planting in northern Iowa.

C. H. Deur, Missouri Valley, Harrison County, Iowa. Bright, No. 1; picked October 25, 1907, stored October 30; May 14, 1908, in prime condition, no scald or decay.

Black Annette. Valued in eastern Iowa for the home orchard because as grown there the tree is hardy and productive and the fruit is of good quality and keeps well into the winter. Not a good commercial variety because it is only medium in size and rather dull in color.


Black Ben Davis. Of the Ben Davis type but more highly colored.

F. O. Harrington, Williamsburg, Iowa County, Iowa. Bright, No. 1, picked September 25, 1906, stored September 26. February 27, 1907, prime condition, no decay nor scald. Deteriorated after this.


L. A. Clemons, Storm Lake, Buena Vista County, Iowa. Picked September 25, 1907, stored October 7. December 7, 1907, in good condition. February 11, 1908, in fair condition. No scald or decay.

Canada Baldwin. Of the Fameuse group, attractive, blushed and mottled with bright red, pleasant aroma, mild flavor, very good quality. Averages below medium size. Keeps somewhat better than Fameuse.

F. O. Harrington, Williamsburg, Iowa County, Iowa. Bright, well colored, No. 1, picked September 25, 1906, stored September 26. February 27, 1907, hard, firm, fine condition, no scald or de-
cay. Deteriorated in flavor some after that time.

Canada Red see Red Canada.

Clemons, syn. Father. A rather attractive red apple of good size and good quality. In season from late fall to midwinter. Tree hardy and productive. Originated by L. A. Clemons, Storm Lake, Iowa.

L. A. Clemons, Storm Lake, Buena Vista County, Iowa. Picked September 14, 1907, stored October 7. February 11, 1908, in good market condition, no scald or decay. Deteriorated after this.

Colorado Orange. A good sized winter apple of rather attractive appearance, bright yellow or greenish sometimes marked with russet, somewhat suggesting the Swaar. May prove valuable for commercial planting in central and northern Iowa. Apparently hardy, vigorous and productive.

H. J. Kyle, Bristow, Butler County, Iowa. Bright large size No. 1, picked October 7, 1907, stored October 8; May 14, 1908, excellent condition, no decay or scald. A valuable green apple for cold storage.


P. F. Kinne, Storm Lake, Buena Vista County, Iowa. No. 1, green, medium size, picked October 5, 1907, stored October 7; December 7, 1907, prime condition, no scald nor decay. Scalded badly after this time.

Dantziger, syn. Dantziger Kant. A handsome fall apple, brilliant red, sub-acid, good quality. Tree hardy and productive.


Delavan. An attractive red late winter apple of medium size or below, mild sub-acid and very good quality. Tree hardy and productive. Originated in Wisconsin.

L. A. Clemons, Storm Lake, Buena Vista County, Iowa. Bright some codling moth, picked October 5, 1907, stored October 7. May 14, 1908, in prime condition, and would probably hold longer. No decay or scald.

Duchess of Oldenburg see Oldenburg.

Father see Clemons.

Gano. Of the Ben Davis type but more highly colored.

F. O. Harrington, Williamsburg, Iowa County, Iowa. Bright, well colored, No. 1, picked October 12, 1906, stored October 13, February 27, in prime condition; no decay nor scald. May 7, 1907, beyond market condition and badly scalded.

Genet or Geniton see Ralls.

Grimes, syn. Grimes Golden. A beautiful rich golden-yellow apple of desirable size and form, excellent for either dessert or culinary use. Of recognized value for commercial planting in central and southern Iowa.


F. P. Spencer, Randolph, Fremont County, Iowa. Bright No. 1, picked September 23, 1907, stored September 25. February 11, 1908, prime condition; no decay nor scald. Scalded after this time.

Ideal see Rome.
Ingram. An apple of the Ralls type but more highly colored being nearly red; much like Ralls in flavor but less juicy, very good quality. So far as tested in Iowa tree appears to rank about with Ralls in hardiness and productiveness.

F. O. Harrington, Williamsburg, Iowa County, Iowa. No. 1, bright, picked October 13, 1906, stored October 14. May 7, 1907, in good condition; no decay, scald slight.

Iowa Blush. A favorite apple for the home orchard in Iowa because the tree is hardy and productive, and the fruit is of good quality and keeps until midwinter. Color attractive yellowish with mottled red or blushed cheek. Fruit too small for market.


Janet or Jeniton see Ralls.

Jonathan. A beautiful brilliant red apple of the Esopus Spitzenberg class and a seedling of that variety. It has high flavor and excellent quality. It excels its parent in hardiness, vigor and productiveness, but not in size and keeping qualities. Recognized as a valuable variety for commercial planting in many parts of central and southern Iowa.

W. H. Fouts, Missouri Valley, Harrison County, Iowa. Bright, medium size, picked October 6, 1906, stored October 7; February 27, 1907, in prime condition; no decay nor scald. Quality deteriorated after this time.


Kinne Seedling No. 1. A good sized, yellowish-green sweet early winter apple. Originated with P. F. Kinne, Storm Lake, Iowa. Tree a shy bearer and less hardy than Wealthy.


Legal Tender see Rome.

Longfield. A clear yellow apple lightly blushed with light red, very tender white flesh of pleasant flavor and very good quality. A moderate grower, hardy and so productive that fruit is apt to run below medium to small. Desirable for home orchards especially in central and northern Iowa.

H. J. Kyle, Bristow, Butler County, Iowa. Bright, medium to small, picked September 18, 1907, stored September 19. December 9, 1907, in fair condition, soft, slightly decayed. Deteriorated rapidly after this. A very tender skinned apple, not valuable for cold storage.

Louise syn. Princess Louise. A rather attractive dessert apple of the Fameuse group, pale yellow with lively red blush. Requires careful handling. In season with Fameuse (Snow).

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W. H. Fouts, Missouri Valley, Harrison County, Iowa. Bright, No. 1, medium to large size. Picked September 13, 1907, stored September 14. December 9, 1907, in fine condition, softening slightly; no decay nor scald, but deteriorated seriously from decay and scald after this time.

McMahon, syn. McMahon White. A large whitish apple often lightly blushed, sprightly acid, only fair in quality; no harder than Wealthy and blights more.

L. A. Clemons, Storm Lake, Buena Vista County, Iowa. Bright, No. 1, picked October 3, 1907, stored October 7. February 11, 1908, fine condition, about commercial limit. No decay nor scald. Deteriorates after this time.

Malinda. A late winter apple, medium or above, greenish, often with a reddish-brown blush, sweet, fair quality. Tree about as hardy as Wealthy, usually free from blight and productive.

D. Wilbur, Floyd, Floyd County, Iowa. Fair, medium size, picked September 30, 1907, stored October 2. December 9, 1907, in excellent condition. February 11, 1908, excellent condition except slightly scalded. After this scald was very bad.

Malinda. A late winter apple, medium or above, greenish, often with a reddish-brown blush, sweet, fair quality. Tree about as hardy as Wealthy, usually free from blight and productive.

Milwaukee. A good sized and fairly attractive winter apple, yellow marked with bright red, somewhat after the style of its parent, Oldenburg (Duchess), flavor briskly acid, quality fair to good.

L. A. Clemons, Storm Lake, Buena Vista County, Iowa. Bright, No. 1; picked September 14, 1907, stored October 7. February 11, 1908, in fair condition, no scald; very slight decay. Should have been stored sooner for best results.

Mann. A hard, green, late winter apple with conspicuous whitish dots, fair to good quality. Hardy enough to be fruited in central Iowa.

F. P. Spencer, Randolph, Fremont County, Iowa. Bright, No. 1; picked September 22, 1906, stored October 13. December 5, 1906, fair condition, beginning to soften; delayed too long before going into storage for best results.

Milwaukee. A good sized and fairly attractive winter apple, yellow marked with bright red, somewhat after the style of its parent, Oldenburg (Duchess), flavor briskly acid, quality fair to good.

L. A. Clemons, Storm Lake, Buena Vista County, Iowa. Bright, No. 1; picked September 14, 1907, stored October 7. February 11, 1908, in fair condition, no scald; very slight decay. Should have been stored sooner for best results.

Nelson. syn. Nelson Sweet. A good sweet late winter apple of good size, green or with a dull blush. Appears to be hardy in central Iowa.

F. O. Harrington, Williamsburg, Iowa County, Iowa. Bright, No. 1, large size, picked October 12, 1906, stored October 13; February 28, 1907, prime condition, hard, good quality, no decay nor scald. Later it scalded badly.

F. O. Harrington, Williamsburg, Iowa County, Iowa. Bright, No. 1, medium size; picked October 25, 1907, stored October 26. May 14, 1908, prime market condition, no decay nor scald. Scalded slightly after this time.

Northwestern Greening. A large to very large greenish-yellow apple, firm, rather coarse, mildly sub-acid, good quality. Has been planted to some extent commercially in central and northern Iowa. Ripens unevenly, some of the fruit is ripe in the fall and some keeps well till spring.

C. H. Deur, Missouri Valley, Harrison County, Iowa. Bright, clean, large size, No. 1; picked September 24, 1906, stored September 25. February 28, 1907, fine condition, hard, no decay nor scald. May 8 a considerable portion past storage limit.

H. J. Kyle, Butler County, Iowa. Bright, large No. 1; picked October 16, 1907, stored October 24; April 10, 1908, in excellent condition; no scald nor decay except a discoloration or eventually a browning within the core lines.

Okoboji. A rather attractive striped red winter apple, above medium
to below, sub-acid, fair to good quality. Introduced by H. N. Antisdel, Milford, Iowa.

H. N. Antisdel, Milford, Dickinson County, Iowa. Poor, green, mixed sizes; picked October 1, 1906, stored October 19; December 6, 1906, in poor condition; not attractive and not valuable for cold storage in this test. Should be tested again.

Patten, syn. *Patten Greening*. An attractive fall apple of good size, greenish color, sub-acid flavor, good culinary quality. A seedling of Odenburg (*Duchess*); hardy, productive; especially valuable for northern apple districts.

C. A. Burnap, Clear Lake, Cerro County, Iowa. No. 1, bright, clear, medium to large size; picked September 14, 1906, stored September 14; December 6, 1906, prime condition; color deteriorates considerably after this time; scalds badly in January.

F. E. Trigg, Rockford, Floyd County, Iowa. Bright, medium size, No. 1, picked September 10, 1907, stored September 12; December 9, 1908, in fair condition, no scald nor decay. Deteriorates badly after this time.

*Princess Louise* see Louise.

Ralls, syn. *Ralis Genet, Geniton, Janet*. A rather dull colored winter apple highly esteemed for home use with recognized, commercial standing. Fruit above medium to small. Tree productive and hardy enough to be grown as far north as Central Iowa.

F. P. Spencer, Randolph, Fremont County, Iowa. Bright, No. 1, medium size; picked October 22, 1907, stored October 28; May 14, 1908, hard, bright, prime condition, no decay nor scald. Would probably have kept some time after this.

Ramsdell Sweet. An attractive red apple of very good size and good quality; in season from mid-autumn to winter.

F. O. Harrington, Williamsburg, Iowa County, Iowa. Bright, clear, No. 1, large size; picked very ripe September 25, stored September 26, 1906; December 6, 1906, prime condition, good color and quality, softening slightly; deteriorated after this time.

Red Canada, syn. *Canada Red*. A handsome red winter apple of the Jonathan group, sub-acid and of very good quality. Hardy enough to be fruited in central Iowa.

F. O. Harrington, Williamsburg, Iowa County, Iowa. Bright, clear, No. 1, large size; picked September 25, 1906, stored September 26; December 6, 1906, in prime condition; no decay nor scald; in fair condition until March.

Roman Stem. A medium sized fall and early winter apple, yellow often slightly blushed, sub-acid and of very good dessert quality. Tree hardy as far north as central Iowa and in favorable locations in northern Iowa. It has been grown commercially to a limited extent in various parts of the State, and is generally valued for home orchards.

F. O. Harrington, Williamsburg, Iowa County, Iowa. Bright clear, small size; picked September 25, 1906, stored September 26; February 28, 1907, in good condition; no scald nor decay. May 8, 1907, wrapped fruit not decayed and but slightly scalded; unwrapped conspicuously scalded.

Rome, syn. *Rome Beauty, Ideal, Legal Tender*. A red late winter apple, mild sub-acid, good quality. Planted to a limited extent in parts of central and southern Iowa.

F. O. Harrington, Williamsburg, Iowa County, Iowa. Bright clear, No. 1, large size; picked October 12, 1906, stored October 13; February 28, 1907, in prime condition; no decay nor scald. Later it scalded badly.
Salome. A midwinter apple of the Ralls *Genet* group, of good red color, sub-acid flavor, medium quality. Bearing trees are scattered in various localities in central and northern Iowa especially along the main line of the Illinois Central Railway. It is gaining recognition as a commercial variety in the above named districts. A valuable apple for cold storage.

F. O. Harrington, Williamsburg, Iowa County, Iowa. Bright, No. 1, medium to large size, picked October 12, 1906, stored October 13; February 28, 1907, in excellent condition; no decay or scald. Scald was slight after this.

H. J. Kyle, Bristow, Butler County, Iowa. Bright, No. 1 medium size; picked October 7, 1907, stored October 8; April 10, 1908, excellent condition; May 14, very firm and of good quality; no scald nor decay.

Scott, syn. Scott Winter. A fairly hardy winter apple of attractive red color but below medium size; flavor sharp acid; quality fair to good. Has been grown to some extent in parts of central and northern Iowa, but its planting is not being extended in any part of the State.

F. O. Harrington, Williamsburg, Iowa County, Iowa. Bright, clear, No. 1, medium to large size; picked September 25, 1906, stored September 26; February 28, 1907, in prime condition; no decay nor scald; May 8 deteriorated slightly.

Sheriff. A fall and early winter apple, medium red color, mild sub-acid flavor and good quality. Grown to some extent in home orchards in central and southern Iowa.

F. O. Harrington, Williamsburg, Iowa County, Iowa. Bright, well colored, No. 1, large size; picked September 25, 1906, stored September 26; January 28, 1907, prime condition, hard, good quality; no decay nor scald; a month later scalded very badly.

Soiree. A yellow fall apple of Minnesota origin; sprightly acid; fair quality.

L. A. Clemons, Storm Lake, Buena Vista County, Iowa. Picked September 25, 1907, stored October 7; December 7, 1907, in fair condition, some are firm; a tender skinned variety of doubtful value in cold storage.

Stayman, syn. *Stayman Winesap*. Distinct from Winesap of which it is a seedling. A winter apple of good size and very good quality. Tree productive and apparently hardy as far north as central Iowa. No reports concerning it have been received from northern Iowa.

F. O. Harrington, Williamsburg, Iowa County, Iowa. Bright, clear, well-colored, No. 1; picked October 13, 1906, stored October 14; January 23, 1907, in fine condition, good quality; no decay or scald; scald severe after this time. May 8 in good condition aside from scald.

Utter, syn. *Utter's Red*. A greenish-yellow fall apple often with more or less red color, medium to large, pleasant sub-acid flavor. Tree is fairly hardy and moderately productive.

F. O. Harrington, Williamsburg, Iowa County, Iowa. Bright, well-colored, No. 1; picked September 25, 1906, stored September 26; December 6, 1906, excellent condition; fine appearance; no scald nor decay; deteriorated after this time.

Wagener. An attractive apple, red with some yellow, sub-acid, excellent quality; in season in late fall and early winter; an old eastern variety which has been fruited in a few parts of Iowa.

F. O. Harrington, Williamsburg, Iowa County, Iowa. Bright, well-colored, No. 1, medium size; picked October 24, 1907, stored
October 26; February 11, 1908, prime condition; good color and quality; no decay nor scald; deteriorated in quality after this time.

Wealthy. Undoubtedly the most important apple now grown in northern Iowa; valuable for home use throughout the State and for commercial planting from south central Iowa northward into Minnesota. It has the size, style and color to commend it as a market apple. Tree hardy and productive. Sometimes blights a little.

L. E. Miller, Clear Lake, Cerro Gordo County, Iowa. Bright, clear, No. 1, mixed sizes; picked September 15, 1906, stored same day; January 24, 1907, in prime condition; March 1, 1907, fair market condition, good quality; no decay or scald.

F. E. Trigg, Rockford, Floyd County, Iowa. Bright, clear, well colored, No. 1; picked September 10, 1907, stored September 12; February 11, 1908, in prime condition; good quality; April 10, 1908, fair condition, firm, good quality; no decay or scald.

Willow, syn. Willow Twig. A late winter apple, large to medium, of medium red color, less attractive than Ben Davis; sub-acid, fair to good quality. Tree thrifty, hardy and productive but somewhat subject to blight.

F. O. Harrington, Williamsburg, Iowa County, Iowa. Bright clear, No. 1; picked October 12, 1906, stored October 13; March 1, 1907, prime, hard condition; no decay nor scald; scalds badly after this time.

Windsor, syn. Windsor Chief. A Wisconsin winter apple. It blights badly in nursery but in many places appears to be making a good orchard record as to hardiness and productiveness. Fruit of good size, rather dark red color, mild sub-acid flavor and good quality.

F. O. Harrington, Williamsburg, Iowa County, Iowa. Bright, clear, well-colored, No. 1, medium to large size; picked September 25, 1906, stored September 26; March 1, 1907, prime in every respect; May 8, 1907, still in fine condition, except for slight amount of scald.

Winesap. One of the oldest and most popular of American apples. When well grown it is of good medium size, bright dark red and very good quality. It is hardy enough to be fruited in central Iowa but does better farther south.

F. O. Harrington, Williamsburg, Iowa County, Iowa. Bright, well-colored, No. 1, medium to large size; picked October 6, 1906, stored October 7; March 1, 1907, prime, hard, good quality; no decay nor scald; later it scalded badly.

F. P. Spencer, Randolph, Fremont County, Iowa. Bright, well-colored, No. 1; picked October 10, 1907, stored October 12; April 10, 1908, prime condition, good quality; no decay nor scald. May 14 slight scald, otherwise in good condition.

Wolf River. A fall apple of the Alexander group, very large, showy, striped red, coarse, sub-acid. Tree pretty hardy. Generally speaking it is not a profitable variety in commercial orchards in Iowa and is now seldom planted in this State.

C. H. Deur, Missouri Valley, Harrison County, Iowa. Bright well-colored, No. 1; picked September 24, 1906, stored September 25; December 6, 1906, in prime condition; no decay nor scald; deteriorates rapidly after this.

H. J. Kyle, Butler County, Iowa. Bright, No. 1; picked September 18, 1907, stored September 19; December 9, 1907, at limit of market condition, beginning to soften; slight amount of decay; the variety is of slight value for cold storage.