# *PROGRESS IN PEAR IMPROVEMENT*[1]

J. R. MAGNESS, Principal Pomologist,
Division of Fruit and Vegetable Crops
and Diseases, Bureau of Plant Industry

THE pear, like the apple, first came to us from western Asia by way of European countries. Its history in Europe closely parallels that of the apple. Apparently indigenous in the region from the Caspian Sea westward into Europe, whence so many of our fruits came, the pear was doubtless used as food long before agriculture was developed as an industry. Hedrick, in the Pears of New York, gives an excellent summary of its history and development during the last 3,000 years.

Nearly 1,000 years before the Christian Era, Homer listed pears as one of the fruits in the garden of Alcinous, thus indicating that they were known to the Greeks of his day. Prior to the Christian Era at least a few varieties were known. Theophrastus (370–286 B. C.) mentioned both wild pears and cultivated named varieties and described grafting. Pliny, of ancient Rome, named more than 40 varieties. With the migrations of the Romans the pear was distributed throughout temperate Europe.

At the time of the discovery of North America, a number of varieties were known in Italy, France, Germany, and England, but there was little progress in the culture of the pear, at least as far as is known, from the early Christian Era until about the beginning of the sixteenth century.

During the eighteenth and nineteenth centuries, there was a tremendous interest in pear breeding and improvement, particularly in Belgium and France. Hardenpont (1705–74), a priest in Mons, Belgium, sowed large quantities of pear seeds and introduced a dozen varieties having soft, melting, buttery flesh. Prior to his time only types with crisp, breaking flesh were known. Whether or not he did any hybridizing is not known. Van Mons (1765–1842), a physician and pharmacist at Louvain, Belgium, developed pear breeding on a large scale. At one time 80,000 seedlings were growing in his gardens. He originated or distributed over 400 varieties, 40 of which have proved of lasting merit.

Many other Belgian and French pear breeders were working on a smaller scale and introduced varieties of great value. The nineteenth century may well be considered the golden era of pear breeding in these countries. Most of the breeding consisted in planting seed of open-pollinated varieties and in selecting the superior types.

[1] This report is made possible only through the cooperation of staff members of the State agricultural experiment stations conducting pear-breeding investigations. Reports for their respective stations were submitted by W. H. Chandler and W. P. Tufts, of California; H. P. Stuckey, of Georgia; A. L. Schrader, of Maryland; A. N. Wilcox, of Minnesota; G. H. Howe, of New York; and F. C. Reimer, of Oregon.

The pear in Europe today, derived from *Pyrus communis* L., takes its place beside the apple in total production, in diversity of varieties, and in popularity. It is far more popular in Europe than in the United States.

## THE PEAR IN NORTH AMERICA

THE early history of pear growing in North America parallels that of apple growing. Pear seed was brought to this country by the early settlers and possibly trees of some varieties. Pear trees were a part of the early colonial orchards. The Prince Nursery catalog listed 42 varieties in 1771.

About that time, however, fire blight or pear blight, the scourge that has frustrated the development of the pear industry in the United States ever since, became epidemic. William Denning, describing the disease in 1794, says he first saw it in 1780 in orchards of the Hudson Valley. How much earlier it might have occurred we do not know, neither are we sure where it came from. It seems most probable that it was present in some native host and became epidemic only when considerable orchard development occurred. Not for another century was the cause of the disease known. In 1882, Burrill, at the University of Illinois, discovered the cause of fire blight to be a bacterium working in the bark tissues.

The disease, which attacks roots, crown, trunk, limbs, blossoms, fruit, and leaves, proved such a menace that pear growing with varieties from Europe, or with seedlings produced from them, never developed to a major industry in the eastern United States. Only in a few sections having relatively cool summers and mild winters has the culture of the European type of pear been successful in the Eastern States. Such conditions are found in relatively narrow strips on the south and east sides of Lake Michigan, Lake Erie, and Lake Ontario. Elsewhere the warm, humid summers have been so

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ALL *of the known species of pears are native to Europe, Asia, and northern Africa. There are no native American species, and none are known in the Southern Hemisphere. Within these species and varieties, however, we have all the characters needed to produce pears suitable for this continent—fruit of high quality, winter-hardy, and above all resistant to fire blight, the scourge that has made the growing of superior pears impossible throughout much of the United States and difficult even in favored regions. To combine these characters properly constitutes a great challenge to the American plant breeder. He has made a small but promising start, and if, with the raw materials available, the problem is not solved within the next century, it will indeed be a reflection on his scientific ability and energy.*

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favorable for fire blight that the development of commercial orchards with these types of pears has not been very successful (fig. 1).

An event of great importanee from the standpoint of eastern pear growing was the introduction of the Chinese or sand pear into the United States. The sand pear (*Pyrus serotina* Rehd.) was growing in the United States by 1840, apparently having come in by way of Europe. These pears are relatively resistant to blight. They are coarse-fleshed, generally contain many grit cells, and are themselves of very inferior quality. Because of their blight resistance, however, they were rather widely disseminated over the eastern United States.

*Figure 1.*—Pear orchard destroyed by fire blight.

Soon hybrids between the sand pear and *P. communis* varieties began to appear. The Le Conte, Kieffer, Garber, Douglas, and more recently the Pineapple, are the most important of these hybrids. All of these are very inferior in quality as eompared to the "buttery" pears of Europe. They are sufficiently resistant to blight, however, to permit growing in most parts of the eastern United States. They are widely planted in home orchards and in small commercial orchards at the present time.

Another event of importance was the importation of a large number of varieties from northern Russia. Since 1879, when the first shipment was made, 70 to 80 varieties have been brought in and tested in Iowa and other northern sections. These are hardy but generally poor in quality and very subject to blight. They are of value only for breeding for hardiness, and probably some of the oriental types that combine hardiness and blight resistance are superior for this purpose.

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In the United States the greatest development of pear growing has centered in the moderately warm, dry valleys of the three Pacific Coast States. Pears were established in California long before that State became a part of the Union, having been introduced by the Mission Fathers with the earliest white settlements. In the valleys of the Pacific States, where there is little summer rainfall and the nights are relatively cool, fire blight is less rampant than in the eastern United States. Most of the European varieties reach a high degree of perfection in these areas. Although blight is a constant menace in many of the sections at the present time, methods have been developed so that it is possible to control it commercially, chiefly by means of careful surgery.

The principal pear varieties grown in the United States today are listed in the appendix, with notes on their origin.

It is apparent that, in contrast to apples, our highest quality pear varieties have mainly been imported directly from Europe. The most important—Bartlett, Anjou, Bosc, and Winter Nelis—are all direct European importations. Among our leading varieties, only those selected primarily because of blight resistance have originated in the United States. These include Seckel, a blight-resistant variety apparently of straight *Pyrus communis* origin, and the *P. communis* × *P. serotina* hybrids. European breeders have worked with pears to a far greater extent than with apples, and in all respects except resistance to fire blight their best varieties have so far proved superior to those that have developed as chance seedlings in the United States.

### Objectives in Pear Breeding in the United States

One objective stands out above all others in the breeding of pears in the United States. This is to secure resistance to fire blight, combined with satisfactory dessert quality. In few regions east of the Rocky Mountains can varieties be grown successfully unless they have a fairly high degree of blight resistance. Varieties available at the present time that have fair blight resistance—primarily *Pyrus communis* × *P. serotina* hybrids—are all of inferior quality as compared to the better *P. communis* varieties. The securing of blight resistance coupled with quality is important in every section of the United States and is the predominent need in at least three-fourths of the potential pear-growing territory of the country.

A second and more localized objective is the securing of additional hardiness in pear varieties for growing in the northern Great Plains and other areas that have very cold winters. Varieties of *Pyrus communis* having good dessert quality do not possess sufficient hardiness to thrive in those regions.

Blight-resistant varieties are needed that also have high dessert and culinary quality and that ripen at intervals from early summer until late fall. Late-ripening varieties with good storage quality are especially needed. At the present time no varieties are available that have these characteristics and are adapted for growing east of the Rocky Mountains. Varieties of European origin meeting these qualifications are grown successfully in the Western States, but even there the problem of blight control is of tremendous importance and involves a heavy expense to growers.

Rootstocks are also needed that combine blight resistance with satisfactory hardiness, congeniality to scions, and adaptation to environment. Fire blight frequently attacks the roots as well as the tops of the trees, and rootstocks that are blight-resistant are a primary need in most regions of the United States where pear growing is attempted.

### Material Available for Pear Breeding in the United States

The cultivated pear varieties of Europe, derived from *Pyrus communis*, generally produce fruit of high quality. Superior varieties produced by European breeders have the buttery texture, relative freedom from grit cells, and aromatic to spicy flavors needed in pears of high quality. While these varieties vary considerably in blight resistance, none of the high-quality European sorts are known to be sufficiently resistant to thrive in the regions where blight is most serious.

The snow pear, *Pyrus nivalis* Jacq., native to southern Europe and cultivated there for making perry, the fermented pear juice popular as a beverage in Europe, is not cultivated in the United States. Trees of this species are very susceptible to blight, and it appears to have little merit as breeding material except possibly for developing perry types if a perry industry should be built up in this country.

The sand pear, *Pyrus serotina*, is native to central and eastern China and is cultivated in China and Japan. The fruit is heavily russeted and commonly apple-shaped, and the flesh is very gritty. Trees of this species are variable in resistance to fire blight but on the average much more resistant than *P. communis*. It hybridizes freely with *P. communis* varieties, and several of the hybrids are important American varieties because of their blight resistance, although all are lacking in quality.

The Ussurian pear, *Pyrus ussuriensis* Maxim., is native to northern China and eastern Siberia. This is the hardiest of pears. The tree is a rather slow grower but very resistant to blight. It is cultivated, and a number of varieties are known in its native habitat. The best of these varieties are soft-fleshed, not excessively gritty, juicy, and subacid to acid in flavor. The trees bloom very early. This appears to be an extremely valuable species for breeding to obtain blight resistance and hardiness.

The Callery pear, *Pyrus calleryana* Decne., is native to central China. The trees are medium to large, vigorous, and bloom early. The fruit is small and seems valueless. The trees are very blight-resistant and may be valuable as stocks for regions having mild winters. They are of questionable hardiness for the colder sections.

The birchleaf pear, *Pyrus betulaefolia* Bunge, is native to central and northern China. The tree is large and vigorous. It blossoms late and produces small, valueless fruit. Many trees of this species are quite susceptible to blight, but there are some resistant types. This species propagates readily from root cuttings, so the blight-resistant types are of possible value for rootstock purposes.

Although there are several other species—a total of 20 to 25 according to the usual botanical classifications—the 6 listed above seem to be of greatest economic importance. All of these species will, so far as known, hybridize readily among themselves.

It is of interest to note that all of the known species of pears are native in Europe, Asia, and northern Africa. There are no native American species; neither are any known in the Southern Hemisphere. Within these species and their varieties we have all of the characters—high-quality fruit, blight resistance, and hardiness—needed to produce pear varieties suitable for North American conditions. To combine these characters in varieties adapted to the different regions of the United States constitutes a great challenge to the American plant breeder. Only a small start has been made on this problem. With the raw materials available, however, if American plant breeders do not solve this problem within the next century it will indeed be a reflection on their scientific ability and energy.

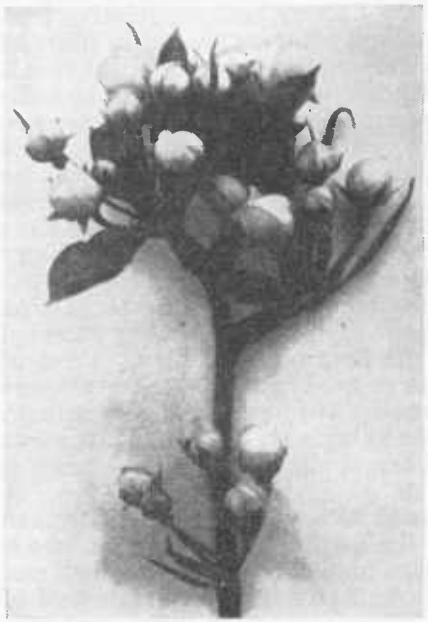

*Figure 2.*—Blossoming spurs of pear, in proper stage of development for emasculation

### Pear-Breeding Work Now in Progress in the United States

The technique of collecting pollen, emasculating blossoms (fig. 2), and cross-pollinating in pears is in all respects similar to that already outlined for apples.

Pear breeding at the California Agricultural Experiment Station was started in 1928. The objective is to obtain superior *Pyrus communis* varieties ripening at intervals throughout the season, including some with good storage quality for holding through the winter months. Approximately 1,700 open-pollinated seedlings of the leading *P. communis* varieties are being grown. In 1931, crosses to give approximately 3,000 seedlings were made. These consisted of Bartlett crossed with Winter Nelis, Easter Beurré, Comice, Hardy, Anjou, P. Barry, and Bosc.

At the Georgia Experiment Station at Experiment, Ga., a considerable collection of varieties is maintained and studied for resistance to blight. Active breeding work is not under way. The variety Sowega, introduced in 1930 by J. J. Parish, Adel, Ga., is reported to be of high quality and very resistant to blight.

Pear-breeding work in Iowa was started by C. G. Patten shortly after 1867. The assistance Patten received from public institutions has been outlined briefly in connection with his work with apples. Patten's work was significant in demonstrating the possibility of developing pears sufficiently hardy to thrive in the upper Mississippi Valley. He grew a large number of open-pollinated seedlings of *Pyrus ussuriensis*. This oriental pear was growing adjacent to *P. communis* varieties, and many of the seedlings are obviously hybrids. The

seedling trees were more vigorous than the original *P. ussuriensis* and proved as "hardy as an oak." These hybrids have proved more hardy in tests during the last 20 years than pears from any other source. Twenty-five of Patten's seedling pears have been selected for further breeding work. One variety, the Patten, a cross of Orel 15 × Anjou, was introduced by the Iowa Agricultural Experiment Station in 1922. Crosses and backcrosses of Patten's seedlings with *P. communis* varieties were made between 1918 and 1928. Much of this work was lost when it was necessary to abandon the station in 1932.

Pear-breeding work at the University of Maryland, College Park, was begun in 1905. Hybrids consisted mainly of crosses of Kieffer with *Pyrus communis* varieties, particularly Seckel and Anjou, although a few crosses of *P. communis* × *P. communis* were made. A total of 1,411 seedlings from crosses made between 1905 and 1917 have been grown to fruiting. Only one, a Kieffer-Anjou hybrid, seems to have merit. A number of these hybrids are being maintained for further determination of their blight resistance.

In Michigan during the period between 1916 and 1919, W. F. Wight and Don Ward, of the United States Department of Agriculture, hybridized pears at the South Haven Horticultural Experiment Station at South Haven. These hybrids were grown to fruiting cooperatively by the Department and the South Haven station. The parents were for the most part moderately blight-resistant types of good quality. Of all the crosses made, Barseck × Bartlett has been most outstanding. A number of the progeny of this cross have produced pears of excellent quality, apparently with some blight resistance, the degree of which has not been satisfactorily determined. A number of these selections are under test in Michigan and at the United States Horticultural Station at Beltsville, Md.

A limited amount of breeding work was started at the Minnesota Agricultural Experiment Station in 1908. The primary objective has been to obtain hardiness and blight resistance. In that year, 300 seedlings of an unknown variety from Manchuria were planted. Two of these have been selected as of horticultural value. Since 1924, a considerable number of hybrids of *Pyrus communis* × *P. ussuriensis* have been made. These are grown in the field without any protection, and only the hardiest survive for planting in the trial orchards. Approximately 700 of these seedlings have survived the Minnesota winters and are being grown to fruiting.

Pear breeding at the New York (State) Agricultural Experiment Station at Geneva started in 1892. Relatively few seedlings were grown before 1906. By 1921, 1,775 seedlings had been grown, most of which have fruited. Approximately 5,000 seedlings have been set out since 1921, of which only a few have fruited as yet. The varieties used in crossing and the number of times they were used are as follows: Anjou, 31; Bosc, 59; Bartlett, 85; P. Barry, 11; Clairgeau, 16; Cayuga, 16; Dana Hovey, 12; Ewart, 10; Gorham, 13; Kieffer, 24; Lincoln Coreless, 12; Ovid, 9; Phelps, 35; Pulteney, 41; Seckel, 77; Sheldon, 20; Tyson, 28; Winter Nelis, 17; and Willard, 17. The New York work has consisted primarily in the hybridizing of *Pyrus communis* varieties to produce high-quality types. The objective has been to obtain pears equal to Bartlett in size, appearance, and quality, but ripening through

a long season. Recently, added emphasis has been placed on the testing of all seedlings for blight resistance. The varieties introduced as a result of the breeding work in New York State are listed in the appendix.

By far the most extensive project in the United States on the testing of known varieties and species of pears for their resistance to blight has been conducted at the Southern Oregon Branch Experiment Station, Talent, Oreg. (fig. 3). Tests have included practically all of the known species, as well as a number of the Asiatic varieties of *Pyrus serotina* and *P. ussuriensis*. Eighty-five *P. communis* varieties and hybrids have been inoculated repeatedly, while 500 pear varieties have been grown in orchard form where they were exposed to natural infection from great quantities of blight in the orchard. The earlier results of these experiments are recorded by Reimer (7).[2] This work gives much information on the relative blight resistance of various *Pyrus* species and varieties and indicates clearly the material of greatest value for breeding for blight resistance.

*Figure 3.*—F. C. Reimer, whose extensive work in determining the extent of blight resistance in practically all known species and varieties of pears serves as a foundation in breeding for blight resistance.

The present work has two objectives—(1) to develop dependable, hardy, congenial, blight-resistant rootstocks for pears; and (2) to develop high-quality, blight-resistant varieties. Ba Li Hsiang, a highly resistant *Pyrus ussuriensis* variety, pollinated with another resistant variety, gave seedlings sufficiently blight-resistant for rootstocks, but such seedlings have proved unsatisfactory for some of the commercial *P. communis* varieties and have been discarded. Seedlings of *P. calleryana* resulting from resistant trees planted so that both pollen and seed parents are resistant have proved highly resistant to blight and appear to be excellent rootstocks in southern Oregon. They may lack sufficient hardiness for the colder sections of the country. By mass selection methods, seedlings of *P. communis* have been found resistant to blight. From 10,000 seedlings, 10 proved highly resistant, and these 10, when pollinated with other resistant varieties, transmit a high degree of resistance. Three of these have produced seedlings 100-percent resistant to root blight when pollinated with another resistant type.

In breeding for resistant varieties of high quality, varieties of *Pyrus ussuriensis* crossed with Anjou, Bartlett, Bosc, and Comice have given only poor-quality varieties, and all have been discarded, though a part of the seedlings were blight-resistant.

[2] Italic numbers in parentheses refer to Selected References to Literature, p. 627.

In 1915, Reimer saw a small Anjou seedling on Benjamin Buckman's farm at Farmingdale, Ill., which was just coming into bearing, with fruit of good size and mediocre quality. The tree was free from blight while the disease was rampant in other varieties surrounding it. Scion wood was obtained and the tree propagated at the Southern Oregon Experiment Station. Extensive inoculation work at the station has proved that this tree is highly resistant to blight. Buckman named the tree Farmingdale in honor of his town.

During the last 5 years several thousand trees have been produced which are crosses between Farmingdale and Anjou, Bartlett, Bosc, Comice, and Seckel. Approximately 75 percent of these seedlings have blighted when inoculated. The remainder have so far proved highly resistant even when repeatedly inoculated. The oldest of these crosses should come into bearing during the next year or two. It is hoped that among these resistant trees at least a small number will possess the good quality of the fine-flavored varieties used as one parent in each cross and the blight resistance of the Farmingdale.

*Figure 4.*—Merton B. Waite, whose experiments in the United States Department of Agriculture showing the necessity for cross-pollination in horticultural varieties of pears led the way to the great amount of research conducted since, not alone with pears but with all orchard fruits. He was also an early leader in breeding pears for blight resistance.

With one exception, all the crosses have proved vigorous. This one exception is Anjou × Farmingdale, these seedlings being only moderately vigorous. Furthermore, the leaves of 20 percent of the seedlings resulting from this cross possessed a waxy white color (devoid of chlorophyll), and the seedlings died when they were from 2 to 4 inches high. This is probably the result of inbreeding, since Farmingdale itself is a seedling of Anjou.

Breeding work to obtain pear varieties resistant to blight was started at the Tennessee Agricultural Experiment Station in 1925, though a limited amount of hybridizing had been carried on earlier. The work since 1925 has consisted of crossing resistant species such as *Pyrus serotina*, *P. ussuriensis*, and *P. calleryana* with the more resistant varieties of *P. communis*. Approximately 3,000 seedlings from these crosses are now being grown, and additional hybridization is under way.

In the United States Department of Agriculture breeding investigations to develop pear varieties resistant to fire blight were started

by M. B. Waite at the Arlington Experiment Farm, Arlington, Va., about 1908 (fig. 4). The early work consisted of crossing Kieffer with Seckel, Anjou, and Bartlett. Several thousand seedlings from these crosses have been grown to fruiting. Several selections made from these earlier seedlings combine good fruit quality with blight resistance. At least one selection seems to be very blight-resistant and has good fruit characters from the standpoint of flesh texture,

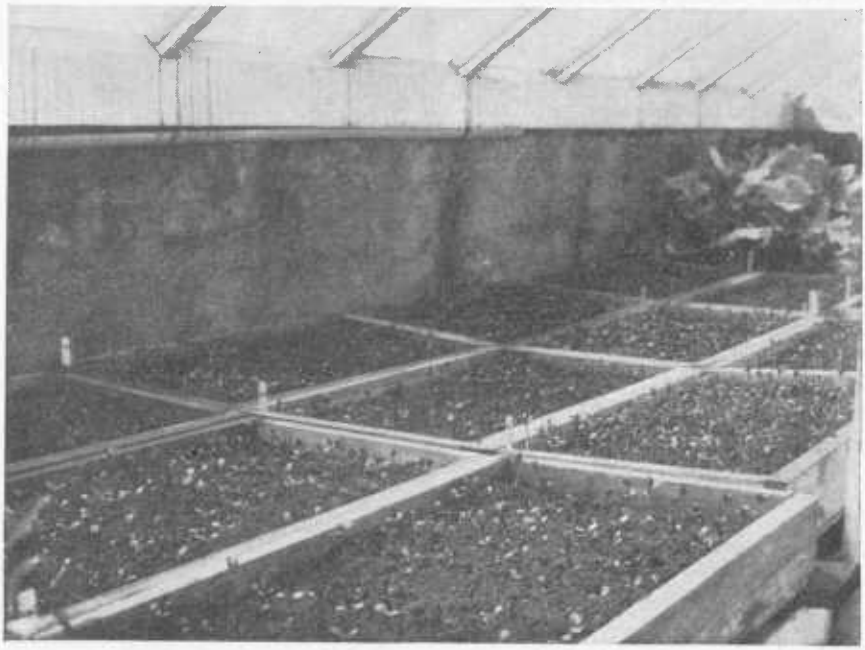

*Figure 5.*—Hybrid pear seedlings growing in the greenhouse.

size, and quality. None of the selections has been named, but they are worthy of general testing. At the present time, around 5,000 seedlings from the above crosses are being grown to fruiting (fig. 5). These are inoculated with blight each year in addition to being exposed to field infection. Resistance to blight, resistance to leaf spot, and fruit characters are being recorded.

A few crosses between high-quality *Pyrus communis* varieties have been made at Palo Alto, Calif., by W. F. Wight, of the United States Department of Agriculture. The purpose in these crosses is to obtain pears of high dessert quality, ripening at intervals through the summer, and also varieties suitable for winter storage.

A list of pear material of special value for breeding purposes, with the institutions at which it is maintained, is given in the appendix. Some of the results of hybridization are illustrated in figure 6.

For a discussion of pear-breeding work under way in other countries, see pages 602–604.

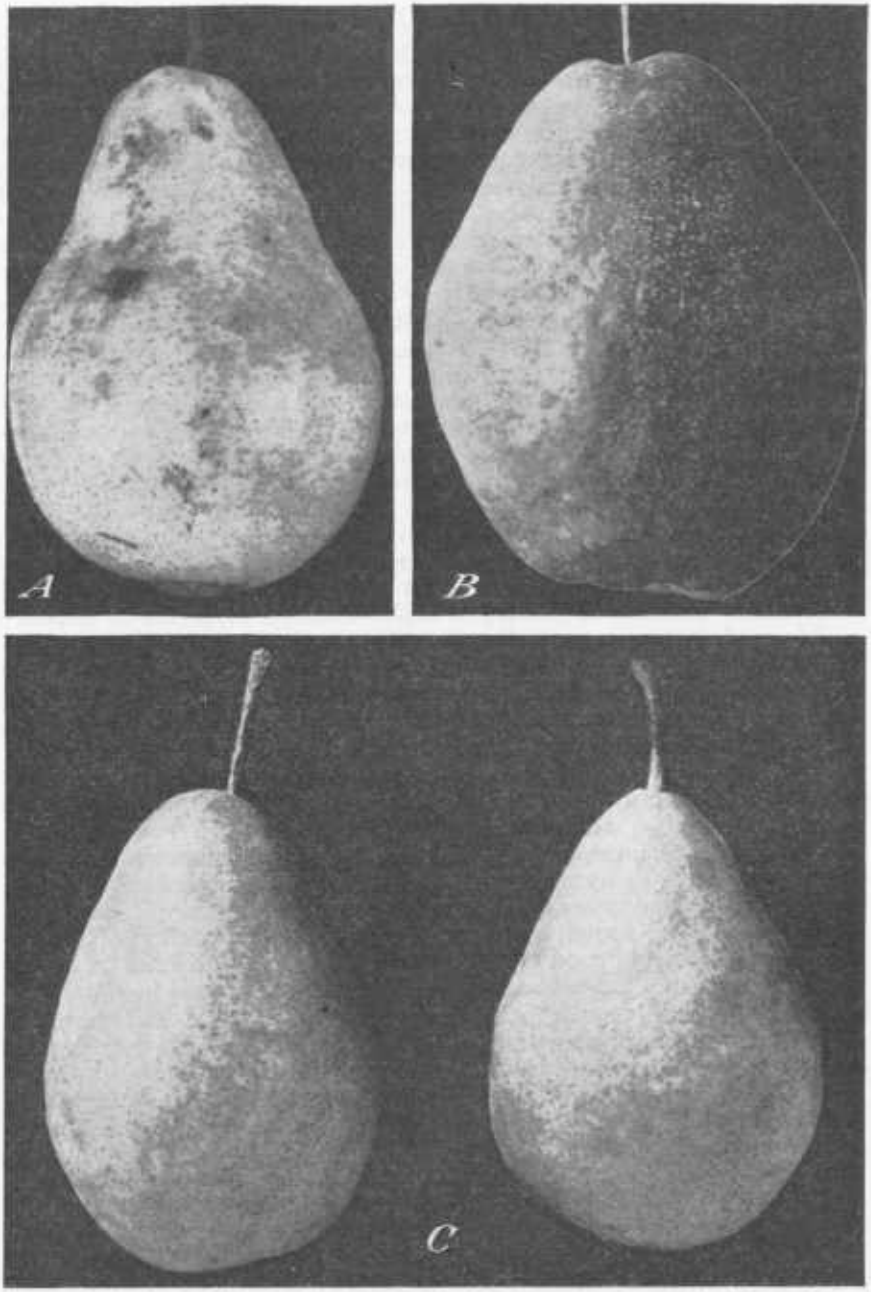


*Figure 6.*—The fruits of hybridization: *A*, Bartlett pear (*Pyrus communis*); *B*, Kieffer a hybrid of *P. serotina* × *P. communis*; *C*, hybrid variety from a cross of Kieffer × Bartlett.

## CYTOLOGY AND GENETICS OF THE PEAR [3]

THE basic chromosome number in the germ cells of pear species is 17, the same as that of the apple. Among European varieties, approximately one-fourth to one-third of those examined to date are triploids, this ratio being about the same as for apples in the United States. These forms with 51 somatic chromosomes, like the triploid apples, generally produce only a small percentage of viable pollen. According to unpublished data from the New York (State) Agricultural Experiment Station, all of the pear varieties important in the United States are diploids with 34 chromosomes in the vegetative tissues. Most of these diploid varieties produce a relatively high percentage of viable pollen.

Recently two bud mutations that may be tetraploids have been found in pears, one in Bartlett, the other in Winter Nelis. These produce giant fruit similar in general appearance to the parent variety but coarser textured. In the case of the Bartlett at least, the fruit is inferior in quality to the parent variety. If cytological examination proves these to be true tetraploids, they may prove to be of much interest and value from the standpoint of breeding, as crosses of tetraploids with diploid varieties should produce triploids.

Few studies have been reported to indicate the type of inheritance that may be expected in pears. Since all varieties of *Pyrus communis* are highly heterogeneous, and since selfing in most varieties is impracticable because of failure of self-pollinated blossoms to produce viable seed, inheritance studies are difficult.

Size of fruit appears to be controlled by many factors. Seckel gives mainly small-sized fruits even when hybridized with large-fruited types, though many intermediate-sized fruits are found in the progeny, a few approaching the size of the larger parent.

The low quality of oriental pears seems to be dominant over high quality of other groups, though intermediate forms sometimes are found. No high-quality progeny has occurred in $F_1$ hybrids of *Pyrus serotina* $\times$ *P. communis* or *P. ussuriensis* $\times$ *P. communis*. In backcrosses of these $F_1$ hybrids with high-quality *P. communis* varieties, some good-quality types result. In 11 trees from Kieffer (*P. communis* $\times$ *P. serotina*) $\times$ Anjou, fruited in 1936 by the Bureau of Plant Industry, fruits of 2 rated good and 4 fair to good. In 132 Kieffer $\times$ Seckel hybrids, fruit of 17 rated as good and 24 as fair to good in quality.

Kieffer, a sand pear hybrid, probably carries russet as a recessive character. In the crosses with russeted Seckel, 23 hybrids were heavily russeted, 45 semirusseted, and 64 smooth. These results indicate that in this cross russet is recessive to smooth skin. Kikuchi has reported that within *Pyrus serotina*, russet behaves as a dominant. In 122 Kieffer (subacid) $\times$ Seckel (sweet) hybrids, 26 produced sweet fruit, like Seckel, 82 subacid fruit, and 14 acid fruit. These results would indicate that, as in apples, sweetness tends to be recessive but that the character is controlled by more than one gene.

No study has yet been reported on the transmission of blight resistance. Reimer finds wide variability in blight resistance of individual seedlings of most of the species studied, with occasional blight resistance appearing in all species studied. Crosses of highly

[3] This section is written primarily for students or others professionally interested in breeding or genetics.

resistant Farmingdale with blight-susceptible varieties have resulted in about 25 percent blight-resistant seedlings in the $F_1$ progenies.

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## APPENDIX

TABLE 1.—*Leading pear varieties of the United States*

| Variety | Parent species | By whom, where, and how originated |
|---|---|---|
| Angouleme | *Pyrus communis* | Wild seedling, Angers, France. Propagated 1808, introduced into the United States before 1830. |
| Anjou | do | A seedling of Van Mons, according to Bunyard. An old French variety, according to Hedrick. Introduced into the United States 1842. |
| Bartlett | do | Raised by a Mr. Stair at Aldermaston, Berkshire, England, about 1770. Brought to the United States about 1797. |
| Bosc | do | A Van Mons variety, 1807. Introduced into the United States in 1832. |
| Clairgeau | do | Raised by Pierre Clairgeau, Nantes, France, about 1830. Introduced into the United States 1854. |
| Clapp Favorite | do | Thaddeus Clapp, Dorchester, Mass. Reported Massachusetts Horticultural Society, 1860. |
| Comice | do | Comice Horticole, Angers, France, 1849. Introduced into the United States in 1850. |
| Dana Hovey | do | Francis Dana, Roxbury, Mass. Introduced 1854. |
| Douglas | (*P. communis* × *serotina*) × *P. communis* Kieffer × Angouleme. | O. H. Ayer, Lawrence, Kans., about 1897. |
| Easter Buerré | *Pyrus communis* | Capucin Monastery, Louvain, Belgium, about 1823; the United States by 1837. |
| Flemish Beauty | do | Wild pear found by M. Chatillon, Alost, Belgium. Introduced by Van Mons 1818; into the United States about 1830. |
| Forelle | do | Germany about 1700, the United States 1823. |
| Garber | *Pyrus communis* × *serotina*. | J. B. Garber, Columbia, Pa., before 1880. |
| Glou Morceau | *Pyrus communis* | M. Hardenpout, Mons, Belgium, about 1750, the United States about 1820. |
| Hardy | do | M. Bonnet, Boulogne-sur-Merd., France, about 1820. Introduced into the United States before 1862. |

TABLE 1.—*Leading pear varieties of the United States*—Continued

| Variety | Parent species | By whom, where, and how originated |
|---|---|---|
| Howell | *Pyrus communis* | Thomas Howell, New Haven, Conn., from seed of Jonah planted about 1830. |
| Idaho | do | Seed planted by Mrs. Mulkey, Lewiston, Idaho, about 1867. |
| Kieffer | *Pyrus communis* × *serotina.* (Probably sand pear × Bartlett.) | Raised from sand pear seed by Peter Kieffer, Roxborough, Pa., about 1863. |
| Le Conte | *Pyrus communis* × *serotina.* | Originated in the United States before 1850. Exact history unknown. |
| P. Barry | *Pyrus communis* | Seedling of Belle Lucrative, raised by B. S. Fox, San Jose, Calif.; fruited 1873. |
| Pineapple | *Pyrus serotina* × *communis.* | Large seedling tree on plantation of Mrs. B. N. Stuckey, Nesmith, S. C.; possibly brought in from China or Japan. |
| Seckel | *Pyrus communis* | Chance seedling near Philadelphia about 1800. |
| Sheldon | do | Premises of Major Sheldon, Huron, N. Y., from seed planted about 1815. |
| Vermont Beauty | do | Seedling in nursery of B. Macomber, Grand Isle, Vt., about 1880. Hedrick says it is indistinguishable from Forelle. |
| Wilder Early | do | Chance seedling found by Charles A. Green in Chautauqua Co., N. Y., about 1884. |
| Winter Nelis | do | Raised from seed by Jean C. Nelis, Mechlin, Belgium, about 1800. |

TABLE 2.—*Pear varieties introduced by the New York (State) Experiment Station*

| Variety | Parentage | Year crossed | Date introduced | Value |
|---|---|---|---|---|
| Cayuga | Seckel, open-pollinated | 1906 | 1920 | Home and roadside markets. |
| Clyde | do | 1908 | 1932 | Home and local market. |
| Covert | Bartlett × Dorset | 1912 | 1935 | Commercial and export. |
| Early Seckel | Seckel, open-pollinated | 1906 | 1935 | Home and roadside markets. |
| Gorham | Bartlett × Malines | 1910 | 1923 | Commercial market. |
| Ovid | Bartlett × Dorset | 1912 | 1931 | Late winter pear. |
| Phelps | Winter Nelis × Russet Bartlett | 1912 | 1925 | Late home and market. |
| Pulteney | do | 1912 | 1925 | Fall home and market. |
| Willard | Bartlett × Dorsett | 1912 | 1931 | Late winter pear. |

TABLE 3.—*Workers on pear breeding in the United States*

| Institution | Location of work | Former workers | Present workers |
|---|---|---|---|
| California Agricultural Experiment Station. | Berkeley, Calif.; Davis, Calif. | | W. H. Chandler, W. P. Tufts. |
| Iowa Agricultural Experiment Station. | Ames, Iowa [1] | C. G. Patten | T. J. Maney, B. S. Pickett. |
| Maryland Agricultural Experiment Station. | College Park, Md | C. P. Close, W. R. Ballard, E. C. Auchter, W. E. Whitehouse. | A. L. Schrader, S. W. Wentworth. |
| Michigan Agricultural Experiment Station and Department of Agriculture. | South Haven, Mich | W. F. Wight, Don Ward. | Stanley Johnston. |
| Minnesota Agricultural Experiment Station. | St. Paul, Minn | | A. N. Wilcox, W. H. Alderman. |
| New York State Agricultural Experiment Station. | Geneva, N. Y. | S. A. Beach | U. P. Hedrick, Richard Wellington, G. H. Howe. |
| Oregon Agricultural Experiment Station. | Talent, Oreg | | F. C. Reimer. |
| Tennessee Agricultural Experiment Station. | Knoxville, Tenn | J. A. McClintock | B. D. Drain. |
| U. S. Department of Agriculture. | Beltsville, Md.; Palo Alto, Calif. | M. B. Waite | J. R. Magness, W. F. Wight. |

[1] Prior to 1932, at State Fruit Farm, Charles City, Iowa.

LISTS OF PEAR MATERIAL OF SPECIAL VALUE FOR BREEDING PURPOSES

The following institutions have trees of practically all of the *Pyrus* species:
Arnold Arboretum, Harvard University, Jamaica Plain, Mass.
California Agricultural Experiment Station, Davis, Calif.
Southern Oregon Branch Experiment Station, Talent, Oreg.

At the California Station the following varieties not generally available are growing:

*Pyrus communis:*
Bollweiller,
Bonnefond,
Bordeaux,
Burkett,
Caisson,
Crocker,
Felix Sahuit,
Guyot,
Lady Clapp,
Large Sugar,
Longworth,
Lowe Seedling,
Marillat,
Messire,
Nantes,
Remy Chatenay,
Sageret,
Souvenir de Cronstadt,
Superfin,
Thirriott.

*P. sinensis:*
Pin Li (P. I. 38263),
P. I. 40352,
Nanshi (P. I. 30352).

At the Minnesota Agricultural Experiment Station, St. Paul, Minn., the following material has been tested for hardiness under field conditions, with the results indicated:

1. Completely winter-hardy, tested 10 to 15 years:
   Minn. Nos. 3 and 4,
   Minn. Nos. 5, 6, and 7 (seedlings of King Karl × sand pear),
   Phiel,
   Russian sand pear,
   Saponsky.
2. Completely winter-hardy, tested 5 years:
   Borgman,
   Cepe Zum Mur (Russia),
   Patten Nos. 5, 1204, 1205.
3. Completely winter-hardy during tests of 3 to 5 years:
   Pushken,
   *Pyrus communis* L., P. I. 47093 et al.,
   *P. ussuriensis ovoidea* Rehd., P. I. 44051,
   *P. ussuriensis* Maxim., P. I. 44235, 44237, 44275, et al.,
   Scandinavian varieties (top-worked branches only):
      Aldonspare,
      Esperen Herripare,
      Furstligt Tafelparon,
      Grapare,
      Grev. A. D. Moltke,
      Johantorp,
      Juli Dekan,
      Lübecker Prinzessinpare,
      Rostbergersmott.
4. Relatively winter-hardy during tests of 3 or more years:
   *P. betulifolia* Bunge, P. I. 39547,
   *P brestschneideri* Rehd.,
   *P. communis* L., P. I. 33207 et al.,
   *P. phaeocarpa* Rehd., P. I. 32741, 39541, 43185, 44276,
   *Pyrus* sp., "Favorita," P. I. 33207,
   *P. ussuriensis* Maxim., P. I. 47094, 55967, 55970,
   Van Fleet hybrid, P. I. 43443.
5. Relatively hardy, but not completely hardy in Minnesota; tested 5 years or more:
   Beierschmitt,
   Chang,
   Mendel,
   Parker,
   Patten Nos. 1200, 1206,
   Simola,
   Tait, Nos. 1, 2, and 4.

6. Other species, severely winter-injured but surviving:
*P. calleryana* Decne., P. I. 47261,
*P. chinensis*,
*P. phaeocarpa* Rehd., P. I. 64229,
*Pyrus* sp., "Surprise," P. I. 45901,
*Pyrus* sp., P. I. 46566, 56012, 64223,
*Pyrus* sp., Van Fleet hybrid, P. I. 55805,
*P. ussuriensis* Maxim., P. I. 46587.

The New York (State) Agricultural Experiment Station, Geneva, N. Y., has the following pear varieties that are not generally available in the United States:[4]

Admiral Gervais, P. I. 91198,
Alexander Lambré, P. I. 91199,
Ba Li Hsaing,
Barronne de Mello,
Baudry,
Belle Guérandaise, P. I. 91200,
Beurré d'Arenberg (syn. of Glou Morceau),
Beurré Bedford,
Beurré Cadelien,
Beurré Dumont
Beurré Fouqueray,
Beurré Six (P. I. 91201),
Ewart,
Favorita,
Fondante Thirriot,
Gdula,
Hessle,
Lung Li, P. I. 46587,
Koestliche von Charmeau,
Kontoula, P. I. 47227,
Laxton,
Laxton Superb,
Louis Pasteur,
Marie Benoist,
Michurins,
Ming,
Ne Plus Meuris,
Noveau Poiteau, P. I. 91207,
Nouvelle Fulvie,
Packham Triumph,
Passe Crassane,
Pastoren Birne (syn. of Vicar of Winkfield),
Petite Marguerite, P. I. 91208,
Petre,
President Barabé, P. I. 91209,
Satisfaction,
Soldat Laboureur, P. I. 91210,
Tang Li,
Triomphe de Vienne,
Vergules,
Miscellaneous *Pyrus* species.

At the Southern Oregon Branch Experiment Station, Talent, Oreg., 500 varieties of pears have been collected. Some of these have died of blight and are no longer available. These are listed in Oregon Station Bulletin 214.

[4] Names are substantially as submitted by the station. Some are not in full accord with the code of nomenclature.