rows and other observational plantings. It produced a very attractive dwarf tree on 'M.26' and a nice semi-dwarf on 'MM 106'. (In a commercial planting nearby, it also was very attractive in fruit). It showed resistance to apple scab in 1973 and this might be one of the reasons for its survival and growth at this location.

CONCLUSIONS

Based on observations after eight years of growth of own-rooted trees in a semi-neglected situation, 'Beauty Crab', 'Olgo Crab', 'Kitaika' and '*M. prunifolia*' (P.I. 205559) should be considered in stock or breeding stocks because of their durability and tree characteristics. In a comparable situation, no 'EM' or 'MM' clones survived. Other test plantings that included 'M.7', 'M.26', 'MM 104' and 'MM 106' as rootstocks, had generally low percentages of tree survival. The same was true of 'Clark' interstems. 'K-41' interstem trees had an acceptable survival rate (88% after 15 years) but were too vigorous for use in high density plantings.

The concept of body working 'Virginia Crab' is archaic in most areas, but the 'Red Sharon' scion yielded a sturdy, productive semi-dwarf tree in the 23rd year. It produced vigorous large trees when topworked to 'Red Delicious' and 'Golden Delicious' in the absence of stem-pitting virus.

'Chieftain' showed promise as a new cultivar because of favorable growth and fruiting on 'M.26', 'MM 104' and 'MM 106' stocks, even under stress conditions.

Pear Rootstock Research in Oregon

PORTER B. LOMBARD AND MELVIN N. WESTWOOD[1]

F. C. Reimer began the search before 1915 for pear rootstocks and interstocks resistant to fireblight. He made two extensive trips to China for seed from native stands of various *Pyrus* species. From these he introduced to the west coast pear industry, such rootstocks as *P. ussuriensis* Max., *P. pyrifolia* (Burm.) Nak., *P. calleryana* Decne., and *P. betulaefolia* Bunge. Also, he (2) selected several *P. communis* L. cultivars resistant to fireblight which were used as interstocks, such as 'Old Home' and 'Farmingdale.' And, seedlings from the crossing of 'Old Home' x 'Farmingdale' (OH x F) were found to be acceptable pear rootstocks.

The rootstock plots Reimer established during the 1920's and 1930's proved important for evaluating resistance to the mycoplasma-induced bud union disorder pear decline which spread through Oregon in the 1950s. Seedlings found to be susceptible to pear decline were *P. ussuriensis* and *P. pyrifolia*, while *P. betulaefolia* and OH x F seedling rootstocks and rooted 'Old Home' interstock trees (1) were the most resistant. Domestic *P. communis* and *P. calleryana* seedlings were moderately resistant (4).

The spread of pear decline in Oregon in the 1950s prompted a new search for pear rootstocks which would: 1) provide resistance to pear decline, fireblight, and other pests; 2) withstand various soil conditions such as heavy clay to light soils; and wet to dry soils; 3) provide high yield efficiency, i.e., high yield per unit of tree size; 4) provide a range of tree

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size control for high density plantings; 5) provide high fruit quality; and 6) provide a range of nutritional levels.

Many pear rootstock plots were established in western Oregon in the 1960s, involving about 17,000 trees. First plantings included seedlings of *P. communis*, *P. calleryana*, and *P. betulaefolia* of different sources from authentic sources. A *Pyrus* species collection was established at Corvallis from native sources in Europe, Africa and Asia, identified by flower, leaf and fruit characteristics. Also, deep planted 'Old Home' on Quince was used for rooting 'Old Home' as a decline resistant stock.

New sources of pear stocks were later found. Various clones of OH x F (developed from hardwood cuttings by Lyle Brooks of Cornelius, Oregon, from over 500 OH x F seedlings) have

Table 1. Relative susceptibility of pear rootstocks to damage from various causes. (0 = not susceptible, 4 = highly susceptible)

Rootstocks	Pear decline	Fire blight	Cold damage	Pear root aphid	Nematodes
P. communis					
Bartlett sd.	2	4	0	4	3
W. Nelis sd.	1	4	0	4	3
Imported French sd.	3	4	0	4	3
OH x F sd.	1	2	0	2	3
Old Home	0	0	0	4	3
OH x F clones	0	1	0	1	3
Bartlett clone	0	4	0	4	3
OPR 1 clone	0	4	0	4	3
P. calleryana	2	0	3	0	0
P. betulaefolia (Reimer's)	0	0	2	0	3
Cydonia oblonga					
E. M. Quince A	0	3	4	0	0
Provence Quince	0	3	4	0	0

Table 2. Relative tolerance of pear rootstocks to certain soil conditions.

Rootstocks	Soil texture preference	Wet soils	Drought	Sensitive to lime induced chlorosis	High uptake nutrients
P. communis					
Bartlett sd.	light	fair	fair	low	Fe
W. Nelis sd.	light	fair	fair	low	Zn
Imported French sd.	light	fair	fair	low	
OH x F sd.	light	fair	fair	low	
Old Home	light	fair	fair	low	Ca, Mg
OH x F clones	light	fair	fair	low	
Bartlett clone	light	fair	fair	low	
OPR 1 clone	light	fair	fair	low	
P. calleryana	light & heavy	good	fair	moderate	K, Ca, B
P. betulaefolia (Reimer's)	light & heavy	good	good	moderate	N, P, K
Cydonia oblonga					
E. M. Quince A	light & heavy	poor	poor	high	Mg
Provence Quince	light & heavy	poor	poor	high	Mg

Table 3. Relative fruit quality and size, tree size and yield efficiency of several pear cultivars on various rootstocks.

Rootstocks	Fruit quality	Fruit size	% of standard tree size	Yield efficiency
P. communis				
Bartlett sd.	good	med.	100	med.
W. Nelis sd.	good	med.	100	med.
Imported French sd.	poor	med.	95	med.
OH x F sd.	good	med.	100	med.
Old Home	good	med.	110	med.
OH x F clones	good	med.	50-110	low-high
Bartlett clone	v. good	med.	60	med.
OPR 1 clone	good	med.	110	high
P. calleryana	v. good	large	95	high
P. betulaefolia (Reimer's)	poor for Anjou v. good for Seckel	v. large	120	low
Cydonia oblonga				
E. M. Quince A	v. good	med.	30	v. high
Provence Quince	v. good	large	40	high

been field tested. Root pieces from high bearing pear trees were collected and tested as rootstocks which were identified as *P. communis, P. ussuriensis,* and *P. calleryana.* Seedling rootstocks from inter- and intraspecific *Pyrus* crosses have been tested. Seedling and clonal stocks of closely related genera such as *Sorbus* (mt. ash), *Cydonia* (quince) and *Crataegus* (hawthorn) were included for tree size control. Compatibility of quince and hawthorn to certain pear cultivars was improved by the use of an 'Old Home' interpiece.

These research programs have identified pear rootstocks which are resistant to various diseases such as fireblight and pear decline, that are adapted to a wide variety of conditions and sites, and which produce trees larger or smaller than standard (3). Summary comparisons of the important rootstocks are presented in Tables 1, 2 and 3.

Recommendations of pear rootstocks should not be limited to a single type, but a variety of stocks should be available to fit the range of conditions, cultivars and planting distances desired. A particular instance where early bloom development is common followed by a late frost, *P. calleryana* rootstock can be used to delay bloom on the variety, because we have noted as much as ten days delay where this stock is used. Or where cork spot of 'Anjou' is a problem due to poor calcium movement in the tree, the use of 'Old Home' clonal root has been found to significantly reduce the incidence.

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