Interspecific Hybrids as Rootstocks for Cherries

James N. Cummins[1]

The sweet and sour cherries grown commercially in the USA are on rootstocks of mazzard *(P. avium)* or mahaleb *(P. mahaleb)* almost exclusively. A limited number of trees in California and abroad are grown on *P. cerasus.* Representatives of several other species have been tried or are under trial (5).

Under the normal stresses of the environments of commercial orchards, shortcomings of each of the stocks thus far tried have become conspicuous and sometimes limiting. For example, *P. avium* is highly susceptible to leaf spot in the nursery row, and probably all strains are highly susceptible to crown gall. With its vertically-oriented root system, mahaleb is sensitive to "wet feet" and to physical impaction of lower soil levels. *P. cerasus* suckers profusely and tends to be difficult to propagate. *P. fruticosa* is difficult to propagate, takes 2 seasons to raise liners to buddable size, and produces very large numbers of suckers.

It is reasonable to hope that some hybrids among the cherry-type *Prunus* spp. would combine the favorable traits and omit the unfavorable traits of the parent species. This approach has been successful in peach rootstock improvement (1), and is promising in apple rootstock breeding (6). Several interspecific hybrids, either from planned hybridization or from natural crossing, are being introduced to the commercial rootstock trade: Colt and Cornflower, *P. avium* x *P. pseudocerasus* crosses from East Malling Research Station (28); and the M x M series from Oregon, presumed natural hybrids between *P. mahaleb* and *P. avium* (29).

In addition to the clones entering commercial channels, a substantial number of interspecific hybrids are or have been under test at various research stations.

In the following review, the author has relied heavily on reports from the Institute for Fruit-Growing at Giessen, German Federated Republic (14, 21) [especially on the monograph of Zylka (35)]; and on the series of reports of Monin and Trefois at the Grand-Manil, Belgium station (18, 23, 24, 25, 26).

Epithets for Interspecific Hybrids

In that literature here reviewed, epithets were found for less than half the interspecific *Prunus* hybrids discussed. Published designations for these materials follow:

P. X *ceropadus* = *P. fruticosa* x *P. maackii*

P. X *dosynekensis* = *P. canescens* x *P. dielsiana*

P. X *dropmoreana* = *P. cerasus* x *P. pensylvanica* (16)

P. X *eminens* Beck. = *P. cerasus* x *P. fruticosa* (20)

P. X *fontanesiana* Schneid. = *P. avium* x *P. mahaleb* (35)

P. X *hillieri* = *P. japonica* x *P. sargentii*

P. X *javorkae* = *P. fruticosa* x *P. mahaleb*

P. X *juddii* Rehd. = *P. sargentii* x *P. yedoensis*

P. X *kubotana* = *P. nipponica* x *P. sargentii*

P. X *maureri* Zab. = *P. incana* x *P. pumila* (20)

P. X *meyeri* = *P. maackii* x *P. maximoviczii* (35)

P. X *mohacsyana* Karp. = *P. avium* x *P. fruticosa*

[1]Department of Pomology and Viticulture, New York State Agricultural Experiment Station, Geneva, New York 14456.

P. X moniwana = *P. apetala* x *P. yedoensis*
P. X pandora = *P. subhirtella* x *P. yedoensis* (14)
P. X schmittii = *P. avium* x *P. canescens* (21)
P. X wadai = *P. pseudocerasus* x *P. subhirtella*
P. X yedoensis Matsum. = *P. serrulata lannesiana* x *P. subhirtella ascendens*

Field Testing of Interspecific Hybrids

Order of the parents of the interspecific hybrids following is alphabetical and does not indicate which species served as seed parent.

P. avium x *P. fruticosa* (= *P. X mohacsyana*). In the trials at Geneva, these hybrids are quite variable in vigor, in internode length, in leaf form, and in susceptibility to mildew and to leaf spot. All produce suckers in large numbers. Dwarfing potential varies from highly dwarfing to fully vigorous. In a small percent incompatibility symptoms have been seen when used under virus-free Emperor Francis sweet cherries or Montmorency tart cherries. Propagability ranges from very easy to very difficult (15). Considerable numbers of this family have also been produced at Balsgard and at Giessen.

P. avium x *P. incisa*. Under Napoleon, early union breakage and some overgrowth of scion has been observed. Hardwood cuttings rooted very early (27). When inoculated with raspberry ringspot virus (RRSV) and with cherry leafroll virus (CLRV), 14/14 seedlings were susceptible (2). Under severe drought stress, East Malling #57 stood up well in England in 1976 (17). At National Fruit Trials, Merton Glory on an unidentified clone has been very productive (7).

P. avium x *P. mahaleb* (= *P. X fontanesima*). These hybrids are proving particularly interesting for their ease of propagation and for their typically high levels of resistance to *Pseudomonas mors-prunorum* and *Ps. syringae* (30). The M x M clones appear to have great potential when used as trunk stocks where bacterial canker is a problem. Moderate growth control is exercised by a few selections, particularly Milbrath, M x M-3, and M x M-39 (29). M x M-14 gave substantial growth control, but the trees appeared more "runted" than dwarfed (29). Montmorency/OCR-3 trees were very vigorous and very productive (30). There have been substan-were unusually efficient (29).

P. avium x *P. pseudocerasus*. At East Malling Research Station, the clonal rootstock F299/2 when pollinated with *P. pseudocerasus* 'Yung Fo' produced 53 seedlings from 1386 pollinations; 2 other *P. avium* seed clones produced no hybrid seedlings (27). Two selections from this cross have been introduced commercially: Colt, as a stock for sweet cherries; and Cornflower as a stock for Japanese flowering cherries. Both are quite easily propagated by cuttings; in a hedgerow, masses of root germs erupt in the basal areas of shoots, a characteristic observed in Yung Fo. Sweet cherries on Colt have been highly productive, ½-size trees. In a National Fruit Trial report, trees of Merton Glory on Colt were almost as productive as the much larger trees on F12/1; selections No. 26 and 33 have been less productive (7). However, both Colt and Cornflower appear to be highly susceptible to drought (17). They are resistant to bacterial canker. Colt appears to be hyper-tial variations in productive efficiency; 6 of the clones tested by Westwood sensitive to CLRV, susceptible to RRSV (2). How Colt will behave under American conditions remains to be seen. Neither stock has been tested in American orchards; plants of Colt have survived 1 winter in western New York. It is unfortunate that neither parent was tested for reaction to American climates and other environmental hazards. Now, the stock will be introduced into commercial channels before even preliminary reports of its evaluation become available.

A wide range of compatibility appears to be one of the major assets of this family. Of some 40 hybrids tested, all were compatible not only with various *P. avium* cultivars but also with *P. cerasus* and *P. serrulata* cultivars. In the nursery, these hybrids grow vigorously and the maiden trees on these stocks are full-sized; in the orchard, a significant compacting effect is exerted on the scion by many of the selections (12).

P. cerasus x *P. pensylvanica*. *P.* X *dropmoreana* is a tetraploid derived by colchicine treatment of the F_1 from *P. cerasus* 'Kozlow Morello' x *P. pensylvanica*; it has been used in North America to a limited extent as a rootstock (11). Open-pollinated seedlings produced Windsor trees somewhat larger than those on mahaleb, and Montmorency trees of standard size (16). The clone used by Garner, propagated by cuttings, originally appeared incompatible with sweet cherry varieties but after 8 years in the orchard, trees were dwarfed, moderately well anchored, non-suckering and satisfactory croppers (12).

P. avium x *P. pumila*. At East Malling, 1900 flowers pollinated produced 4 seedlings (27); these were susceptible to RRSV and to CLRV.

P. avium x *P. wadai*. At East Malling, 1660 flowers gave 1 seedling (27). That 1 is susceptible to both RRSV and CLRV.

P. campanulata x *P. incisa*. Clone #15-2-K at Grand-Manil gave very vigorous trees of Griotte du Nord, poor compatibility with Wimmertingse (25).

P. cerasus x *P. pseudocerasus*. At East Malling, 300 flowers pollinated with Yung Fo gave 1 seedling (27).

P. incisa x *P. sargentii*. At Grand-Manil, a clone tested as #9-1-R performed adequately under Schneiders but exhibited poor compatibility with Wimmertingse (25).

P. incisa x *P. serrula*. At Grand-Manil, #9-14-K was one of the most promising stocks tried. Compatibility with the sweet cherry cultivars tried was good, with growth much reduced. Growth of Montmorency was reduced by about half (25).

P. mahaleb x *P. pumila*. At East Malling, 239 flowers pollinated produced 1 seedling (27); this was susceptible to both RRSV and CLRV (2).

P. nipponica x *P. sargentii* (=*P.* X *kubotana*). The Grand-Manil clone #11-2-R, a cross of *P. nipponica kurilensis* x *P. sargentii*, appeared to be compatible and dwarfing with Hedelfingen, but was not satisfactory with other cultivars (25).

P. X *pandora* x *P. subhirtella*. Hally Jolivette, tested as #8-2-K, was perhaps the most useful single stock in the Belgian trials. Compatibility was excellent, and very substantial dwarfing occurred (25). An Arnold Arboretum introduction, Hally Jolivette trees are available at many American nurseries.

P. pseudocerasus x *P. subhirtella* (= *P.* X *wadai*). Garner obtained fair nursery success with this stock (43%), but trees were very vigorous. Mortality in the orchard was high, usually occurring as a ground-level rotting of tissue (12).

P. sargentii x *P. subhirtella*. Accolade, tested at Grand-Manil as #1-4-R, performed well under most sweet cherries except Schneiders, with considerable reduction of growth. Montforency trees were about ¼ standard size (25). This flowering cherry is widely available in the American nursery trade.

P. sargentii x *P. yedoensis* (= *P.* X *juddii*) is under test at Grand-Manil as #10-1-R (25).

P. subhirtella x *P. serrulata*. Dwarf Siberian was introduced in 1964 as a dwarfing rootstock.

P. subhirtella rosea x *P. yedoensis* (= *P. X pandora*). A clone tested at Grand-Manil as #16-1-R exhibited good compatibility and considerable dwarfing under Wimmertingse, but was quite unsuitable for Montmorency and Burlat (25). Micro-propagation methods have been successfully applied.

Discussion

Large numbers of interspecific hybrids have been produced in the breeding programs at Giessen, German Federated Republic, and at Muncheberg, German Democratic Republic. Both have emphasized crosses involving representatives of the subgenera Eucerasus and Pseudocerasus (21, 33). Their results of studies on nursery compatibility and orchard behavior have not been published. It seems probable that among such families as *P. X pandora* x *pseudocerasus*, *P. incisa* x *P. canescens*, and *P. subhirtella* x *P. avium* there will be clones which demonstrate highly desirable horticultural properties.

At the present stage of testing the various interspecific hybrids as cherry rootstocks, it is not possible to estimate the adaptability of these candidates to aspects of the orchard environment which are, in many regions, critical to success. Thus, Colt and Cornflower, highly promising in the relatively mild climate of southeastern England, have not been examined for response to the more rigorous winter climates of Michigan and New York. We have only fragmentary information on the tolerance of the Oregon M x M *(P. X fontanesiena)* selections for limited soil aeration. Whether any of the best candidates from the Grand-Manil tests will survive the *Pseudomonas* pressure of the Willamette Valley remains to be seen. None has been examined for reaction with tomato ringspot virus nor for reaction with various nematodes.

Conclusions

The most important capabilities and limitations of the more prominent clones and seed lines of mazzard and mahaleb rootstocks have been identified. Several interspecific hybrids, now being introduced as rootstocks for cherries, appear to hold much promise, but their adaptabilities to specific regions of the USA and Canada have not been defined. Orchard testing of the most promising selections should proceed apace, but it would be additionally appropriate to subject these candidates to intensive testing under controlled conditions for reaction to those environmental hazards to which they are most likely to be exposed under commercial conditions.

Literature Cited

1. Bernhard, R., Ch. Grasselly and J. Sarger. 1977. Possibilities d'emploi des hybrides F_1 intra-et interspecifiques pour l'amelioration et la selection des portes-greffes d'arbres fruitiers a novau. *Publ. 439, Sta. Recherch. Arb. Fruit, La Grande-Ferrade.*
2. Cropley, R. 1968. Testing cherry rootstocks for resistance to infection by raspberry ringspot and cherry leaf roll viruses. *Rpt. E. Malling Res. Sta. for 1967.* pp. 141-143.
3. Crosse, J. E. 1977. Plant pathology. *In Rpt. E. Malling Res. Sta. for 1978.* p. 128.
4. Cumming, W. A. 1958. Propagation of *Prunus* species and varieties. *Proc. Int. Plant Prop. Soc.* 8:85-91.
5. Cummins, J. N. 1979. Exotic rootstocks for cherries. *Frut Var. J.* 33:74-84.
6. ———— and H. S. Aldwinckle. 1975. Broadening the spectrum of rootstock breeding. *Proc. 19th Int. Hort. Congr.* 3:303-312.
7. Dodd, P. B. 1975. Sweet cherry: Dwarfing rootstock trial FR 38/1 progress report. *In Annu. Rpt. Natl. Fruit Trials for 1974.* pp. 50-51.
8. Fischer, A. and M. Schmidt. 1938. Wilde Kern-und Steinobstarten, ihre Heimat und ihre Bedeutung für die

Entstehung der Kultursorten und die Züchtung. *Züchter* 10:157-167.
9. Fleming, R. A. 1963. Rootstocks for ornamental trees. *Ontario Hort. Expt. Sta. Rpt. for 1962*. pp. 46-49.
10. Floor, J. 1957. Report on the selection of a dwarfing rootstock for cherries. *Euphytica* 6:49-53.
11. Fogle, H. W., J. C. Snyder, H. Baker, H. R. Cameron, L. C. Cochran, H. A. Schomer and H. Y. Yang. 1973. Sweet cherries: production, marketing, and processing USDA Handbk. 442. 94 pp.
12. Garner, R. J. 1972. Dwarfing rootstocks and interstems for sweet cherries. Atti 2d Covegna del Ciliegia, Verona. pp. 101-111.
13. Garner, R. J. and C. P. Nicoll. 1957. Observations on *Prunus cerasus, P. mahaleb*, and other species as rootstocks for sweet cherries. *Rpt. E. Malling Res. Sta. for 1956*. pp. 63-72.
14. Gruppe, W. and H. Schmidt. 1977. Die Bewurzelung von Stecklingen verschiedener Kirschhybriden und Arten unter Sprühnebel. *Gartenbauwissenschaft* 42:132-135.
15. Huallanca, H. and J. N. Cummins. 1974. Rooting capacities of some *Prunus fruticosa* x *P. avium* hybrids. *HortScience* 9:123-124.
16. Hutchinson, A. and W. G. Upshall. 1964. Short-term trials of root and body stocks for dwarfing cherry. *Ont. Hort. Exp. Sta. Rpt. for 1963*. pp. 8-16.
17. Jackson, J. E. 1977 Cherry rootstocks. *In Rpt. E. Malling Res. Sta. for 1976*. pp. 46-49.
18. Monin, A. 1968. La nanification der cerisier. *Symp. Kirschen & Kirschanbau, Bonn*. pp. 13-16.
19. Mowry, J. B. 1958. Rootstocks for propagating *Prunus* selections. *Fruit Var. Hort. Dig.* 13:23-25.
20. Rehder, A. 1949. Manual of cultivated trees and shrubs hardy in North America. Macmillan, New York. 996 pp.
21. Schmidt, H. 1972. Problems in interspecific hybridization and the selection of dwarf rootstocks for cherries. Atti 2d Convegno del Ciliegia, Verona. pp. 65-74.
22. Stebbins. R. L., J. R. Thienes and H. R. Cameron. 1978. Performance of sweet cherry cultivars on several clonally propagated understocks. *Fruit Var. J.* 32:31-37.
23. Trefois, R. 1972. Nanification du cerisier par la voie botanique. *Le Fruit Belge*, 4th trimester. pp. 285-318.
24.__________. 1974. Possibilities nouvelles de production de cultivars de cerisiers sur les sujets porte-greffe produits par bouturage sous brouillard. *Le Fruit Belge* 42 (368):262-281.
25. __________ and A. Monin. 1972. Comportments differentiels de combinations de greffage de varieties de cerises sur des Prunus ornamentaux et autres. *Sta. Cult. Fruit & Maraich., Gembloux, Belgium*, 72-50-CER, 69 pp.
26. Trefois, R. and A. Monin. 1978. Personal communications.
27. Tydeman, H. M. and R. J. Garner. 1966. Breeding and testing rootstocks for cherries. *Rpt. E. Malling Res. Sta. for 1965*. pp. 130-134.
28. Webster, A. D. and D. G. Chapman. 1975. Cherry rootstocks. *Rpt. E. Malling Res Sta. for 1974*. p. 46.
29. Westwood, M. N. 1978. Mahalab x mazzard hybrid cherry stocks. *Fruit Var. J.* 32:39.
30. Westwood, M. N., A. N. Roberts and H. O. Bjornstad. 1976. Comparison of mazzard, mahaleb and hybrid rootstocks for Montmorency cherry (*Prunus cerasus* L.). *J. Amer. Soc. Hort. Sci.* 101: 268-269.
31. Williams, E. 1961. Dept. of Plant Breeding. *Rpt. John Innes Hort. Inst. for 1960*. pp. 7-17.
32. Wolfram, Bridgitte. 1966. Stand und Aussichten der Züchtung einer Schwachwachsenden Kirchunterlage. *Obstbau* 6:68-88.
33. __________. 1966. Erste Ergenbnisse bei der Züchtung einer Schwachwachsenden Kirschunterlage. *Tagungeber. Deutch Akad. Landwiss., Berlin*. pp. 93-97.
34. Zwintzscher, M. 1962. Cherries. *In Handbuch der Pflanzenzüchtung* 6:573-602.
35. Zylka, D. 1971. Die Verwendung von wilden Kirscharten in der Sortenzuchtung und als Unterlage. *Gartenbauwissenschaft* 36:261-291, 417-444, 557-572.

Cultivar Workshop on Grape, Apricot, Pear, *Rubus* and Blackberry to be presented by the American Pomological Society at the annual meeting, August 3, 1979—see page 108.