Apple Rootstocks

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Today I would like to summarize the apple rootstock trials being grown at the Plant Materials Center in Palmer and at other trial sites throughout the state. First, I would like to discuss the importance of rootstocks. When you bring up the topic of rootstocks, people often ask "Why do we need new apple rootstocks? Aren't their own roots good enough?" Yes, sometimes their own roots are "good enough", but others may be better.

Rootstocks are used when plants are budded or grafted as a means of asexual propagation. There are many different purposes for propagating plants by budding or grafting. Hartman and Kester (1983) list the following purposes for budding and grafting:

> perpetuating clones that cannot be maintained by cuttings, layers, divisions or asexual methods
> obtaining the benefits of certain rootstocks; examples would be resistance or tolerance to diseases and insects, and poorly drained soils, having improved hardiness and tree-size control (Cummins, and Aldwinckle, 1974)
> changing cultivars of established plants
> hastening the reproductive maturity of seedling selections in hybridization programs
> obtaining special forms of plant growth
> repairing damaged parts of trees
> studying virus diseases

Not all apple scions or tops are compatible with all apple rootstocks. The most popular apple rootstock used in Alaska, Malus baccata, is known to be incompatible with several apple varieties used for fruit production (Nelson, 1968). Nelson states that incompatible combinations are considered less hardy. This does not mean that Malus baccata, which is compatible with some crabapple varieties, should not be used in Alaska. It does mean that it would be to our advantage to find additional apple rootstocks hardy in Alaska.

External appearances first attributed to signs of graft incompatibility include: no union or low percentage of bud or graft take, high degree of decline and mortality or breakage, stunted trees, swollen unions, decline in annual wood production or root growth, and late bud break (Nelson, 1968). As Nelson states, these appearances are not caused only by graft incompatibility. Other cultural, mechanical and environmental factors may also contribute to these responses. However, certain signs of incompatibility are due to a mechanical weakness at the union because there is a discontinuity of the bark and wood.

Rootstocks which have a high degree of compatibility with the apple varieties being tested and are sufficiently hardy, are being sought in trials. As Babb (1959) states, the lack of winter hardiness is a common reason for the failure of tree fruit cultivation in Alaska. Hardiness is difficult to determine, especially in an area as diverse and varied as Alaska. Test winters determine whether a plant can survive in conditions other than the "normal" winter (Davidson, 1985). According to Davidson, test winters do not affect all parts of the region equally and they occur irregularly. As in Beaverlodge, Alberta, it is usually the weather in the fall, early winter or late winter, or great fluctuations in temperatures which determine plant survival, not extreme or average coldness. Because of their varied conditions, plant survival for 15 years has been set as the basic measure for hardiness of apple varieties in the Beaverlodge region (Davidson, 1985).

By that scale, the apple rootstock trials done by the Plant Materials Center are very young. They began in 1982 when several apple rootstocks were brought in for budding scion wood received from the Saanichton Research and Plant Quarantine Station, Saanich, British Columbia, and the IR-2 Program in Prosser, Washington.

Since that year, several different apple rootstocks have been used in the trials. The decision about which rootstocks to use came from discussing the trial with Alaska Agriculture Experiment Station researchers, Dr. Don Dinkel and Dr. Curtis Dearborn, and Alaskan and other northern nurseries. Information from research done in other northern states or provinces has also been utilized.

Some surprises were found in the search for hardy apple rootstocks. Redalen (1982) reports that the main rootstock varieties used in Norway include Malling-Merton 106, Malling 26 and Malling 9. Most Malling rootstocks are not reliably hardy in Alaska. Malling 26 has survived in very protected locations in Anchorage. But the few planted at the Plant Materials Center did not survive. Other rootstocks used in the trial include:

> Malus anis a fairly recent introduction to the United States that is widely used in Northern Europe. It is the preferred rootstock in Finland and is supposed to have all of the good qualities of M. 'Antanovka' and M. borowinka (Lawyer).
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> Malus 'Antanovka' has been used in southcentral Alaska and the Fairbanks area with some success. It has good compatibility with apple cultivars (Lawyer).
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> Malus baccata reported to be the hardiest apple available, has been widely used in Alaska. A problem of delayed graft incompatibility exists with some apple cultivars. Apple cultivars, usually crabapples, with M. baccata are successfully grafted onto this rootstock. Many of the hardy Canadian apple cultivars also contain M. baccata genes (Lawyer).

Malus bittenfelder is a domestic apple. Lawyer reports that it is one of the most widely used apple seedling rootstocks worldwide. It is not as hardy, but is vigorous and compatible with many cultivars. The biggest advantage in using M. bittenfelder is that it produces very uniform stands.

Malus borowinka was used as a rootstock in 1984. It was reported to have "nothing but good qualities, including compatibility, vigor, and hardiness" by Esther Lawyer. However, very few survived the first winter.

Malus 'Budagovsky 118' is a development of the breeding program of the Michurin Institute near Moscow, USSR. It is reported as being almost as hardy as M. 'Robusta 5' and virus-free. It exhibits tree-size control similar to that of M. 'Malling 26' (Cummins and Aldwinkle, 1974).

Malus columbiana had been used in rootstock trials in Fairbanks (Dinkel).

Malus pepin safran is a domestic apple species used in the Soviet Union (Lawyer).

Malus prunifolia is in the parentage of many of the hardy crabapples (Cummins and Aldwinkle, 1974 and Lawyer). Seedlings of these crabs are often used as rootstocks. It is often used as an indicator for apple viruses. This may account for it failing to survive. However, it produces an excellent root system and is very hardy. The scion wood used in the apple trials had been certified virus-free by the Saanichton Research Station decreasing the chance of transmitting viruses to the rootstock.

Malus ranetka had been used in Lithuania and survived winters which killed M. antanovka in the early 1930's (Gravitis). It had also been used in Fairbanks area and found to be hardier than M. 'Antanovka' (Dinkel).

Malus 'Robin' was suggested by Lawyer's Nursery. It had been reported as being a very hardy rootstock.

Malus Sargentii is recommended in the Prairie Regional (Zonation) Trials for Woody Ornamentals for the Morden area (Collicut, L. M., H. H. Hiebert, and R. Enns, 1984). It had also been suggested by Esther Lawyer in a personal communication.

Malus 'Selkirk' is recommended for all of the sites participating in the Prairie Regional Trials. It was also highly recommended by L. M. Collicut and H. Hiebert during a tour of the Morden Research Station in 1982.

Malus 'Wien' is a selection made by John Holmes in Fairbanks. It has been commercially available from Lawyer's Nursery in Plains, Montana.

Table 1. Summary of the survival of the apple rootstocks field-planted in Palmer.

Rootstock	Year Planted	Number Planted	Surviving 1987	Percent Surviving
M. anis	'85	17	0	0
M. 'Antanovka'	'83, '84, '85	90	4	4
M. baccata	'84, '85	79	48	61
M. bittenfelder	'85	3	0	0
M. borowinka	'85	1	0	0
M. 'Budagovsky 118'	'85, '86	10	8	80
M. columbiana	'85	22	1	5
M. pepin safran	'84, '85	52	0	0
M. prunifolia	'84, '85	63	7	11
M. ranetka	'84, '85	44	21	48
M. 'Robin'	'85	51	12	24
M. sargentii	'85	16	0	0
M. 'Selkirk'	'84, '85	57	16	28
M. 'Wein'	'82	22	21	95

Apple scion wood and rootstocks were received in February or March. The scion varieties were then chip-budded or T-budded onto each of the rootstocks being tested that year. The plants were potted into gallon pots or, in 1984 and 1985, tree pots and placed in the greenhouse.

Rootstocks were cut off above the bud when growth from the bud began or approximately four weeks after being budded. Buds breaking on the lower portion of the rootstock were removed as required. The plants were grown in the greenhouse until late spring. They were then moved outside where they were grown for the rest of the summer. Plants were overwintered in the cold frame, healed into the lath house or in the University of Alaska Agriculture and Forestry Experiment Station cooler. The coolers were kept between 28° F and 32° F. Plants were field-planted one year after being budded.

The trials in Palmer suffered the greatest amount of winter kill during the 1985-1986 winter. That winter should probably be classified as a "test" winter. Our "test" began in the early fall, September and October 1985. During September, there were only four nights the minimum temperature went below 32° F. Between October 1 - 18, there were only 11 days with a minimum temperature of 32° F or below.

Those minimum temperatures ranged between 20° F - 32° F. The minimum temperatures then dropped to 11° F on the 19th. From October 19 to the 31st, the minimum temperatures ranged from 20° F to -8° F. The plants had not gone sufficiently dormant when the lower minimum temperatures were experienced. The cold temperatures with no snow accumulation, continued through November and into December 1985. This period was followed by a relatively warm period through February 15, 1986, when the temperatures dropped again. The witer killing damage most likely occurred in October when several days of sub-zero minimum temperatures were recorded.

In 1985, apple rootstocks that had not been budded or grafted were planted at each of the Delta, Fairbanks and Kenai trial sites. Table 2 summarizes their survival at each site.

Table 2. Summary of the apple rootstocks planted in 1985 at the Delta, Fairbanks, and Kenai Cooperative Plant Trial Sites.

Rootstock	Location	Number Planted	Surviving 1987
M. 'Antanovka'	Delta	3	0
M. baccata	Delta	3	3
M. bittenfelder	Delta	3	
M. columbiana	Delta	3	0
M. 'Robin'	Delta	3	0
M. anis	Fairbanks	3	1
M. 'Antanovka'	Fairbanks	3	0
M. baccata	Fairbanks	3	1
M. bittenfelder	Fairbanks	3	0
M. columbiana	Fairbanks	3	
M. 'Robin'	Fairbanks	3	2
M. anis	Kenai	3	0
M. 'Antanovka'	Kenai	3	0
M. baccata	Kenai	3	3
M. bittenfelder	Kenai	3	0
M. columbiana	Kenai	3	2
M. 'Robin'	Kenai	3	3

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