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Quality and Mineral Content in 'Swiss Bartlett' Pears Grown on Clonal Old Home x Farmingdale, Clonal Quince and Seedling Rootstocks

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Abstract

Fruit weight, firmness, percent soluble solids, titratable acidity, and flesh Ca, Mg, K, P and N content of 'Swiss Bartlett' pears were different among several clonal Old Home x Farmingdale (OH x F), clonal Quince and seedling rootstocks. No rootstock was found to be superior but fruit calcium in pears grown on OH x F 230 rootstock was significantly higher than in fruit grown on all the other rootstocks. Fruit calcium and nitrogen contents were higher in the fruit from trees at age 5 to 6 yrs than in fruit from the same trees at age 11-13 yrs. Fruit Mg, K and P showed no trend with tree age.

Introduction

Recent reports by Denby and Meheriuk (2) and Kappel and Quamme (5) have identified several clonal Old Home x Farmingdale (OH x F) rootstocks for commercial use in pear plantings in British Columbia and Ontario, respectively. Two OH x F selections, 69 and 87, were more precocious and had higher yields than most of the other rootstocks in these studies but no effects on fruit quality

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were reported. The influence of several clonal OH x F, two seedling and two clonal Quince rootstocks in five growing seasons (1979, 1980, 1985, 1986, and 1987) on 'Swiss Bartlett' pear quality and mineral content are presented in this paper.

Materials and Methods

'Swiss Bartlett' was field grafted in the spring of 1974 onto rooted cuttings of OH x F clones (34, 51, 69, 87, 130, 230, 333 and 515). Old Home, Bartlett, EM Quince A and Lepage Quince C. The block consisted of four adjacent rows, each divided into three consecutive plots. Each plot contained single trees on each rootstock arranged in a systematic order, thus, each rootstock was replicated 12 times. All trees were spaced at 2.4 x 4.8 m, trained to a central leader and irrigated by overhead sprinklers. Fruit were picked at a flesh firmness of 89-94 N and pooled across each plot within rows 1 and 2 and rows 3 and 4. Each rootstock was, therefore, represented by 6 replicates. A sub-sample of 15 pears was randomly withdrawn from each replicate at harvest and evaluated for individual fruit weight, skin color, firmness, soluble solids content and titratable acidity. The remaining fruit was stored in 0°C air for 60 days and another subsample of 15 pears was withdrawn for the same analyses.

Skin color was read on a Golden Delicious Apple Color Meter (Techwest Industries Ltd., Vancouver, B.C., Canada) and firmness was measured with a Magness-Taylor penetrometer (5.6 cm tip). Sectors from each pear in the 15 fruit sub-samples were juiced in a commercial juicer. Juice samples were titrated with 0.1 N NaOH to pH 8.1 and percent soluble solids were determined with a refractometer. Additional sectors free of skin, carpel tissue and seeds were freeze-dried, ground, ashed and then subjected to atomic absorption spectrophotometry for mineral analysis.

Data were analyzed by ANOVA with all sources of variation except that associated with rootstock differences combined in the error term to provide a conservative test in the absence of randomization within plots.

Results and Discussion

All trees on OH x F 51 failed to survive beyond the second year of planting and no data are available on this rootstock. Average fruit weight (g) was higher in EM Quince A and lower on OH x F 130 than from most other rootstocks (Table 1). Flesh firmness at harvest was higher for Lepage Quince C than most other rootstocks. Percent soluble solids at harvest were narrowly confined (10.8 to 11.5%) and the lowest values were recorded for OH x F 130 and 230. Titratable acidity was more variable and was higher in fruit from OH x F 515 than in fruit from OH x F 34 and 130 and Bartlett seedling. Skin color was not influenced by rootstock. Flesh firmness after storage was higher in fruit from Quince C than from all other rootstocks except Quince A. Percent soluble solids, titratable acidity and skin color showed few or no differences with respect to rootstock after storage.

Flesh calcium content was higher in fruit on OH x F 230 than from all other rootstocks (Table 2). Flesh magnesium was higher in fruit on OH x F 130 than from the other rootstocks except for OH x F 230, Quince A, and the two seedling rootstocks. Flesh potassium was lower from OH x F 230 than from the other rootstocks except for OH x F 34, 87 and 333 and Old Home seedling. Flesh phosphorous and nitrogen showed relatively few differences with rootstock.

Compared to mature trees (1985 to 1987), flesh calcium and nitrogen contents were higher in 1979 and 1980 when the trees were young and beginning to bear (Table 3). Flesh Mg, K and P did not show any comparable trend with tree age. The ratio of grow-

Table 1. Fruit quality in 'Swiss Bartlett' grown on several clonal Old Home x Farmingdale (OH x F), seedling, and Quince rootstock.[z]

	At harvest					After 60 days at 0°C			
Rootstock	Fruit weight (g)	Skin color[y] (0-10)[x]	Firmness (N)	Soluble solids (%)	Acidity[x] (mg)	Firmness (N)	Skin color[y] (0-10)	Soluble solids (%)	Acidity[x] (mg)
OH x F 34	185 ab[v]	0.41 a	86.7 cde	11.2 abc	394 c	80.0 c	1.00 a	11.4 ab	318 b
OH x F 69	187 ab	0.43 a	86.7 cde	11.4 a	441 ab	80.0 c	1.19 a	11.7 ab	369 a
OH x F 87	176 bc	0.43 a	86.9 cde	11.4 a	434 ab	80.5 bc	1.06 a	11.6 ab	378 a
OH x F 130	150 e	0.44 a	85.3 e	10.8 d	417 bc	78.4 cd	1.02 a	11.1 bc	352 ab
OH x F 230	158 de	0.41 a	87.5 bcd	10.8 d	430 abc	79.3 cd	1.08 a	10.6 c	357 a
OH x F 333	165 cde	0.44 a	85.6 de	11.0 cd	438 ab	77.5 d	1.23 a	11.1 bc	364 a
OH x F 515	156 de	0.42 a	86.4 cde	11.2 abc	458 a	78.4 cd	1.26 a	11.3 ab	372 a
EM Quince A	193 a	0.46 a	88.9 ab	11.5 a	438 ab	82.3 ab	1.18 a	11.9 a	378 a
Lepage C Quince	187 ab	0.45 a	89.3 a	11.4 ab	441 ab	83.1 a	1.05 a	11.8 a	375 a
Old Home sdlg	155 de	0.45 a	86.6 cde	11.1 bcd	424 abc	79.6 cd	1.17 a	11.3 ab	358 a
Bartlett sdlg	166 cd	0.43 a	87.9 abc	11.0 cd	397 c	79.2 cd	1.17 a	11.4 ab	317 b

[z]Mean values for the years 1979, 1980, 1985, 1986 and 1987.
[y]Color of 0 = very green to 10 = very yellow.
[x]Titratable acidity expressed as mg malic acid per 100 ml juice.
[v]Mean separation within columns by Duncan's multiple range test, P = 0.05.

ing tips to fruit number may explain the higher fruit calcium found in the younger trees. Al-Ani and Richardson (1) showed a marked reduction in movement of calcium into the fruit if a growing tip was present. Higher flesh nitrogen in fruit from the younger trees may be consequence of a higher fruit to leaf ratio.

Fallahi and Larsen (4) noted that fruit mineral content (Mg, Ca, K, P, N) in 'Bartlett' and 'Anjou' pears grown on Bartlett and Old Home seedling rootstocks were not statistically different except for a higher K level in 'Bartlett' grown on Old Home seedling rootstock. 'Swiss Bartlett' in our study had a higher fruit K content on Bartlett than on Old Home seedling rootstock (Table 1).

A study by Fallahi and Larsen (3) showed no difference in firmness for 'Bartlett' or 'Anjou' in 'Bartlett' and 'Anjou' at harvest or after storage when grown on Bartlett or Old Home seedling rootstocks. Percent soluble solids at harvest in the latter study was higher in 'Bartlett' pears grown on Old Home

Table 2. Fruit nutrition in 'Swiss Bartlett' grown on several clonal Old Home x Farmingdale (OH x F), seedling, and Quince rootstock.[z]

Rootstock	Fruit Ca (ppm, d.w.)	Fruit Mg (ppm, d.w.)	Fruit K (ppm, d.w.)	Fruit P (ppm, d.w.)	Fruit N (%)
OH x F 34	566 e[y]	476 c	8279 bcd	855 abc	0.40 a
OH x F 69	622 bcd	483 bc	8610 ab	866 ab	0.39 a
OH x F 87	650 bc	489 bc	8375 abcd	857 abc	0.35 b
OH x F 130	677 b	519 a	8703 a	874 a	0.38 ab
OH x F 230	772 a	501 abc	8188 d	862 abc	0.35 b
OH x F 333	669 b	494 bc	8399 abcd	858 abc	0.35 b
OH x F 515	649 bc	494 bc	8716 a	819 abc	0.37 ab
EM Quince A	603 cde	495 abc	8538 abc	798 c	0.37 ab
Lepage C Quince	583 de	488 bc	8616 ab	803 bc	0.40 a
Old Home sdlg	665 b	506 ab	8220 cd	821 abc	0.35 b
Bartlett sdlg	669 b	503 ab	8641 a	849 abc	0.38 ab

[z]Mean values for the years 1979, 1980, 1985, 1986 and 1987.
[y]Mean separation within columns by Duncan's multiple range test, P = 0.05.

Table 3. Average nutrient content of 'Swiss Bartlett' pears in each of 5 seasons (pooled across all rootstocks).

	Flesh content (ppm, d.w.)				Flesh
Year	Ca	Mg	K	P	N (%, dw)
1979	798	463	8812	1009	0.43
1980	782	521	7540	841	0.46
1985	599	504	9579	920	0.32
1986	542	507	8236	517	0.32
1987	531	480	8161	935	0.33

seedling rootstock but the content in 'Anjou' pears was not different between the two rootstocks. Our results with 'Swiss Bartlett' showed no differences in fruit firmness or soluble solids content when grown on Bartlett or Old Home seedling rootstocks (Table 1). Fruit weight averaged across six pear cultivars in a study by Lombard and Westwood (6) was not different between Bartlett or Old Home seedling rootstocks. Our results showed no effect of either rootstock on fruit weight in 'Swiss Bartlett' pears (Table 1). Fruit weight for 'Harvest Queen' was not influenced by rootstock in the 1976 trial by Kappel and Quamme (5), but their 1977 trial showed fruit size to be larger on Quince A and OH x F 69 than on Bartlett seedling, OH x F 333 or OH x F 51. Our results also agree with the latter study except for OH x F 51 where no data were available.

In summary, rootstocks do appear to affect fruit quality and fruit nutrition but no single rootstock predominated for a given feature except for calcium in fruit grown on OH x F 230. This has interesting implications for disorders like 'Anjou pit' that arise from low flesh calcium content. Whether the higher calcium content would prevail with other scions is unknown. Data from the present and previous studies indicate differences in fruit quality and mineral content grown on different rootstocks but these differences often are of a slight nature and not of commercial significance.

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