

Growth and Production of 'Bing' and 'Schmidt' Sweet Cherries on Several MxM or East Malling Cherry Rootstocks

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Abstract

'Schmidt' and 'Bing' sweet cherries were planted in 1982 at the Washington State University Royal Slope Research Unit near Othello, WA. 'Bing' was grafted onto EMCR (East Malling cherry rootstocks) 15, 16, 21, 38, and 50. 'Schmidt' was grafted onto Mazzard seedling and onto MxM (Mahaleb x Mazzard) rootstocks 14, 39, and 97. Data on growth and production are reported for the first 8 years of commercial production. 'Bing' trees were largest on EMCR.38 and were smallest on EMCR.50. Rootstock had no significant effect on cumulative yield of 'Bing', which averaged 203 kg tree⁻¹ after 8 years. Cumulative yield efficiency for 'Bing' was highest from trees on EMCR.16 or EMCR.50, and was lowest from trees on EMCR.15 or EMCR.38. The largest 'Schmidt' trees were on Mazzard seedling rootstock, and the smallest were on MxM.14 or MxM.97. Rootstock had no significant effect on cumulative yield of 'Schmidt', which after 8 years averaged 66 kg tree⁻¹, and had no effect on cumulative yield efficiency. All tested MxM rootstocks offered some degree of size control, relative to 'Schmidt'/Mazzard seedling, but productivity of 'Schmidt' was low.

Introduction

The two major rootstocks used for sweet cherry production, Mahaleb (*Prunus mahaleb*) and Mazzard (*Prunus avium*) seedlings, have been in cultivation for centuries (7). Neither rootstock, however, produces dwarf trees (11). As a result, growers and horticultural scientists are searching for dwarfing cherry rootstocks from among several sources (13, 14). A brief history of cherry rootstock research was presented in an earlier paper (5). Our objective for the work reported here was to test several rootstocks from among selections of Mahaleb and Mazzard hybrids (MxM.), originating in Oregon, and

from among selections made at the East Malling Research Station for their effects on relative tree size and production potential. The East Malling selections were crosses of *Prunus avium* x *Prunus pseudocerasus* Lind. and carried the designations Fb.2/58- followed by the numbers 15, 16, 21, 38 and 50. While these selections were of considerable interest at one time, they have not provided the degree of dwarfing originally envisioned. However, Fb.2/58-21 of this series was named 'Colt' and released to the industry (personal communication with Dr. A. D. Webster). For convenience, these stocks will hereafter be referred to by the letters EMCR (East Malling cherry rootstock) followed by their respective number.

Materials and Methods

'Schmidt' and 'Bing' sweet cherries were planted in 1982 at the Washington State University Royal Slope Research Unit near Othello, Washington. 'Schmidt' scions were grafted onto Mazzard seedling and MxM rootstocks 14, 39, and 97. 'Bing' was grafted onto EMCR 15, 16, 21, 38, and 50. 'Bing'/Mazzard or Mahaleb seedling were not included except in the guard rows due to lack of available trees. Each scion and rootstock combination was planted in 3 replicates in three-tree plots in rows with an east-west orientation in a completely randomized design. Within-row tree spacing was 4 meters, and rows were spaced 7 meters

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apart. Trees were delayed open-center trained. The entire experimental planting was surrounded by a guard row, planted at the same spacing, with trees of 'Bing'/Mazzard or Mahaleb seedling rootstocks.

A grass- and weed-free strip was maintained under the trees with herbicides. Perennial grasses were seeded between the rows. Under-tree sprinklers were used for irrigation. The soil was an Adkins fine, loamy sand on a uniform, nearly level slope with a south-facing aspect. The field had been previously planted to alfalfa. Standard fertilizer and pest control programs were used uniformly on the entire block.

Trunk cross-sectional area for each tree (20-25 cm from the ground) and yield for each plot were measured annually, starting in 1987. No commercially-significant crop was produced during the first five years. Trunk cross-sectional area was used as a measure of tree size (12). Cumulative yield efficiency was calculated by dividing the mean cumulative yield per tree within plots for a given year by the mean trunk cross-sectional area within the same plot for that year.

Trunk cross-sectional area, mean cumulative yield and cumulative yield efficiency as of the last year of the study (1987-1994) were analyzed within scion cultivar as a completely randomized design using SAS PROC GLM (8). Null hypotheses were rejected at $P \leq 0.05$. Duncan's Multiple Range Test was used when the analysis of variance indicated a significant difference among means. For the analysis of trunk cross-sectional area, each tree was an observation unit. For cumulative yield and yield efficiency, the units of observation were the plots. All data were converted to a per-tree basis.

Results

'Bing'. Trunk cross-sectional area was significantly affected by rootstock

($P = 0.0007$). 'Bing'/EMCR.38 was significantly larger than on EMCR.21, 16 or 50, and trees on EMCR.50 were significantly smaller than trees on EMCR.15 or EMCR.38 (Fig. 1).

There was no significant effect of rootstock on cumulative yield of 'Bing' after 8 years of production ($P = 0.3746$). Mean cumulative yield (over all rootstocks) after 8 years was 203 kg tree⁻¹.

Rootstock had a significant effect ($P = 0.0005$) on cumulative yield efficiency of 'Bing'. 'Bing'/EMCR.50 had a higher yield efficiency than trees on EMCR.21, 15 or 38, and trees on EMCR.15 or 38 had a lower cumulative yield efficiency than all other 'Bing' trees (Fig. 1).

'Schmidt'. Trunk cross-sectional area was significantly affected by rootstock

Table 1. Some reports of cherry rootstock effects on tree size and production for various scion cultivars. Rootstocks used were various clones of MxM (Mahaleb x Mazzard) hybrids or Mazzard seedling (unless otherwise noted). Most references included additional rootstocks, but results only for rootstocks used in the present study are summarized here.

Reference	Rootstock	Results
10	MxM.14 MxM.39	MxM.39 had higher yield than MxM.14.
9	MxM.97	MxM.97 produced smaller trees than Mazzard F 12/1.
1	Mazzard MxM.39	MxM.39 produced larger trees than Mazzard.
7	Mazzard MxM.97 MxM.39 MxM.14	Vigor of MxM.14 lower than Mazzard; yield of MxM.14 lower than Mazzard. Results for MxM.39 and MxM.97 depended on geographic location.
2	Mazzard MxM.97 MxM.39	MxM.39 had lower crop load than MxM.97 or Mazzard.

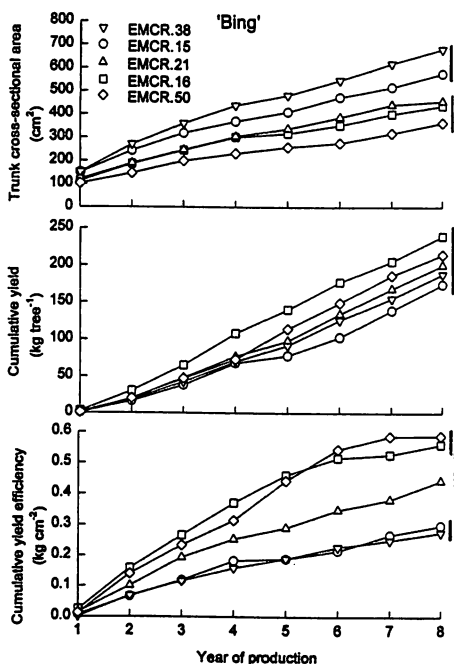


Figure 1. Trunk cross-sectional area, cumulative yield and cumulative yield efficiency over 8 years of commercial production for 'Bing' sweet cherry on EMCR (East Malling cherry rootstocks) 15, 16, 21, 38 or 50. Trees were planted in central Washington State in 1982; year 8 of production was 1994. Means from year 8 of production that are adjacent to a common vertical line are not significantly different (Duncan's multiple range test. $P \leq 0.05$).

($P \leq 0.0001$). 'Schmidt' trees on Mazzard seedling were larger than trees on all other tested rootstocks; trees on MxM.39 were smaller than trees on Mazzard seedling, but were larger than trees on MxM.97 or 14 (Fig. 2). The smallest trees were those on MxM.97 or 14.

There was no significant effect of rootstock on cumulative yield of 'Schmidt' after 8 years of production ($P = 0.0720$, Fig. 2). Mean cumulative yield (over all rootstocks) after 8 years was 66 kg tree^{-1} .

Rootstock had no significant effect on 'Schmidt' cumulative yield efficien-

cy ($P = 0.1883$, Fig. 2). Overall mean yield efficiency was 0.118 kg cm^2 .

Discussion

The results for both 'Bing' and 'Schmidt' provided evidence that some of the tested rootstocks produced smaller trees than others. After 12 years in the ground, 'Schmidt'/MxM.14 or MxM.97 had about 55% of the trunk cross-sectional area of 'Schmidt'/Mazzard seedling, the largest tested rootstock. Furthermore, yield of these smaller trees was not significantly less than the larger trees in their first 8 years of production. Based on similar experiments of longer duration (e.g., 3, 4, 5), we predict that within a few years, however, cumulative yield of 'Schmidt'/MxM.14 and MxM.97 will be significantly less than for 'Schmidt'/MxM.39. Given that 'Schmidt'/MxM.39 produced a tree that was about 77% of the trunk cross-sectional area of 'Schmidt'/Mazzard seedling (Fig. 2), it appeared that in our orchard MxM.39 offered the best combination of size control and production potential of the tested MxM. rootstocks.

Several comparisons of trees on various MxM. and Mazzard rootstocks were available from previous studies (Table 1). Our results, along with those of earlier reports, supported several general conclusions. Trees on Mazzard or MxM.39 were generally large, although the ranking between these two rootstocks varied (cf. 1, Fig. 2). Trees on MxM.14 were comparatively small and unproductive (7, 10, Fig. 2). Trees on MxM.97 were comparatively small, but no clear trends were evident regarding relative productivity of trees on this stock (cf. 2, Fig. 2).

Among the EMCR. tested, EMCR.16 and EMCR.50 were particularly noteworthy. 'Bing'/EMCR.16 had about 65% of the cross-sectional area of the largest trees, 'Bing'/EMCR.38. 'Bing'/EMCR.50 had only 51% of the cross-

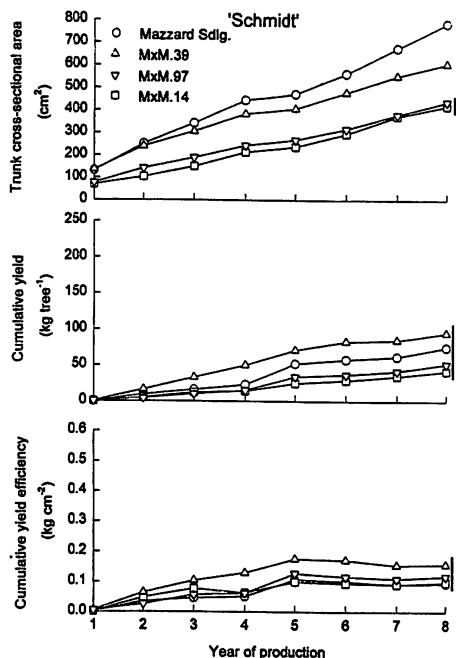


Figure 2. Trunk cross-sectional area, cumulative yield and cumulative yield efficiency over 8 years of commercial production for 'Schmidt' sweet cherry on Mazzard seedling rootstock or MxM (Mahaleb x Mazzard) rootstocks 14, 39, or 97. Trees were planted in central Washington State in 1982; year 8 of production was 1994. Means from year 8 of production that are adjacent to a common vertical line are not significantly different (Duncan's multiple range test, $P \leq 0.05$).

sectional area of 'Bing'/EMCR.38. Although cumulative yield of 'Bing' on these smaller trees was not significantly different than 'Bing'/EMCR.38 after 8 years of production (Fig. 1), the smaller trees ranked higher in cumulative yield. Cumulative yield efficiency for 'Bing'/EMCR.50 and 'Bing'/EMCR.16 was substantially higher than for the largest 'Bing' trees (Fig. 1).

Additional evidence of size control came from a comparison of experimental trees with trees in adjacent guard rows which were 'Bing'/Mazzard seedling or 'Bing'/Mahaleb seedling of the same age. Mean trunk cross-sectional area of these non-experimen-

tal 'Bing'/Mazzard seedling and 'Bing'/Mahaleb seedling trees in 1995 was 688 and 558 cm², respectively, vs. the experimental 'Bing' trees on EMCR.38, 15, 21, 16 and 50, which had cross-sectional areas of 758, 592, 501, 460 and 351 cm², respectively.

No direct comparisons were available of cumulative yield of 'Bing' on the EMCR series with those of 'Bing' on Mazzard or Mahaleb seedling rootstocks. It is noteworthy, however, that in an adjacent, bordering experimental orchard, cumulative yield of 'Bing', averaged over trees with either Mazzard or Mahaleb rootstocks, was 110 kg tree⁻¹ after 14 years in the ground (5). This cumulative yield was substantially lower than the 203 kg tree⁻¹ (averaged over all rootstocks) reported in the present paper for trees that had been planted for 12 years. This comparison suggests that trees on EMCR rootstocks may be more productive than trees on Mazzard or Mahaleb seedling stocks. Although this research indicates that some of the tested rootstocks may have commercial potential, rootstock influence on fruit quality should be evaluated since the best rootstocks in terms of growth and production do not necessarily produce the best cherries (6, 7).

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Allelism for the White-Flowered Phenotype in Sixteen Diverse Peach Clones

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Abstract

Controlled crosses were made to test 16 diverse peach [*Prunus persica* (L.) Batsch] clones for allelism of the white-flowered (anthocyanin deficient) phenotype. Most of the F₁ progeny were anthocyanin deficient, but an occasional anthocyanin positive seedling occurred, presumably due to outcrossing in the field. The results showed that all sixteen white-flowered peach clones tested are allelic for the anthocyanin deficient phenotype.

Additional index words. *Prunus persica*, flowers, anthocyanin, tree fruits, genetics.

Introduction

The petals of wild-type peach flowers are pink. Peach fruit and leaves are reported to produce more than one type of anthocyanin (7, 13), but cyanidin-3-glucoside is the predomi-

nant anthocyanin in peach petals (1). Peach trees with red, white, or variegated flowers also exist. Lammerts (8) demonstrated that the white flowered phenotype is controlled by the W (white-flowered) locus. Individuals that are homozygous recessive *ww* are white flowered and are anthocyanin deficient in all plant parts. The W locus exerts recessive epistatic control over the pink/red flower locus (*R*) and the red/green leaf locus (*Gr*), (1). White-flowered peach trees have been in existence for hundreds and possibly thousands of years. Downing and Downing (2) described two white-flowered clones; 'Snow' and 'White-Blossomed Incomparable.' Hedrick (4)

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