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Influence of Pruning and Interspecific *Prunus* Hybrid Rootstocks on Tree Growth, Yield and Fruit Size of Apricot

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Abstract

In 1991 a trial was established to determine the effect of two interspecific hybrid rootstocks and two pruning systems on the growth and fruiting of 'Sundrop' apricot. The rootstocks evaluated were Haggith (standard), M800 (*Prunus besseyi* x *P. sibirica*), and Yuksa (*P. besseyi* x *P. armeniaca*). The two pruning systems were Central Leader and Spanish Bush. At the end of the experiment trees pruned to the Central Leader were the tallest and had the largest canopy spread. No difference in trunk cross-sectional area was found between the two pruning systems. There was no difference in tree height among the rootstocks, but trees on Haggith had the largest canopy spread and trunk-cross-sectional area and trees on M800 were the smallest. Yield was not affected by pruning; however, fruit from the Spanish Bush system were the smallest. Trees on Haggith had the highest yield and the largest fruit. It appears that the Spanish Bush pruning system may be a satisfactory system for apricots. The lower yields and smaller fruit of trees on M800 suggests that it should not be recommended as an apricot rootstock.

Introduction

Apricots (*Prunus armeniaca* L.) are vigorous trees that require a rootstock to reduce the vegetative vigor and maintain production and fruit quality. Reduced vigor, that is smaller trees, could lead to improved production efficiency, especially improved labor efficiency. The predominate rootstock at present is apricot seedling with some peach seedling and plum rootstocks being used (1). Incompatibility between the scion cultivar and the rootstock is a problem when species other than *P. armeniaca* are used as rootstocks. Apricot seedling has been the most useful rootstock, both in regards to scion compatibility and adaptability to the soils and climatic conditions around the world where apricots are grown. Haggith is an apricot seedling released by Agriculture Canada as a vigorous, hardy, and compatible rootstock for apricot (11). It is a good rootstock for apricot, except for the lack of dwarfing of the scion. Interspecific hybrids have been tried with limited success. These include Citation and Marianna 2624 (14), and GF 31 (1). Hybrids between *P. armeniaca* and other *Prunus* species have been suggested as possible rootstocks or interstocks for apricots. Two such hybrids are Yuksa, a hybrid of *P. besseyi* and *P. armeniaca* (8) and M800, a hybrid of *P. besseyi* and *P. sibirica* (10). It has been reported that Yuksa and M800 can be used as compatible interstocks between apricot scions and hardy *P. americana* rootstocks (9, 15). Hutchinson (9) mentioned that these hybrids were to be used as rootstocks in trials in Ontario; however, no reports verifying their performance can be found. Yuksa has been used in rootstock trials for peach (5) and nectarine (6).

Without a good size-controlling rootstock, pruning and training is used to control the vegetative growth of apricots. Several studies have examined the use of training and pruning as means to control vegetative growth (2, 3, 4, 13, 14). Results varied among the various studies with Y-trained systems out-yielding other systems in some cases; in other cases palmettes or axe systems had higher yields. The Spanish Bush training system for sweet cherries is being used in various cherry growing regions around the world (12). It is characterized by heading cuts of lateral branches,

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usually made during the summer. The goal is to have a "pedestrian" orchard, that is where most of the pruning, fruit thinning, and harvesting can be done from the ground. Central leader pruning of apricots is not generally practiced; however this system more easily allows for increased planting density. Increasing plant density increases the early production of the orchard.

The objective of this trial was to evaluate two rootstocks (Yuksa and M800) and two pruning systems (Central Leader and Spanish Bush) and determine their effect on vegetative growth and cropping of apricot.

Materials and Methods

'Sundrop' apricot trees for the study were planted at the Pacific Agri-Food Research Centre at Summerland B.C., Canada in the spring of 1991. Three rootstocks Haggith (control), M800 and Yuksa and two training systems (Central Leader [CL] and Spanish Bush [SB]) were used. Spacing was 5 m between rows and 4 m between trees within rows.

The CL trees were pruned each year during the dormant season (late winter to early spring) by heading the leader to remove about one-half of the previous season's growth. Initially, all the laterals were headed by removing about one-third of the one-year-old wood. Some lateral branches were removed each pruning season, that is, those branches that were too vertical (60° or greater from the horizontal) or were crossing other branches. Once branches began to encroach into the tractor alley they were shortened by cutting back to a side branch in a more desirable location. After the trees reached a height of 3.5 to 4.25 m the leader was cut back to a weak lateral and it was headed by removing about one-half of the current season's growth. This branch then became the new "leader".

Trees trained to SB were summer pruned each year when most of the current season's growth reached 0.6 to 0.8 m in length. About one-half of the current season's growth was removed from every branch on the tree. Minimal dormant pruning was done. Branches that needed to be removed to facilitate orchard operations such as fruit thinning or harvesting and vertical branches were removed. As with the CL trees, once branches began to encroach into the tractor alley they were shortened by cutting back to a lateral branch.

Fruit were hand thinned each season by removing enough fruit to space the remaining fruit about 10 to 15 cm apart. All other orchard practices (pest control, irrigation, fertilization, etc.) were done according to local standard practices.

The experiment was designed as a split-plot with pruning system the main plots and rootstocks the sub-plots. There were 5 single tree replicates. Data recorded included trunk cross-sectional area (TCA) at the end of each growing season (cm^2), annual yield (kg), average fruit weight (g), and tree height (m) and width (m) were measured before dormant pruning. Data were analyzed by analysis of variance using the GLM procedure (SAS Institute, Cary, N.C.) and the LS means were separated using least significant difference (LSD).

Results

Vegetative Growth. Final tree height was significantly affected by pruning system but not by rootstock (Table 1). There was a significant interaction between pruning system and rootstock. Haggith trees pruned to CL were the tallest trees (Table 2). There was no difference in tree height between M800 and Yuksa trees pruned to the CL. All CL trees were taller than SB trees. There were no differences in tree height among the trees on different rootstocks pruned to the SB pruning system. SB trees reached about 90% of their final height by the third year after planting whereas CL trees didn't reach 90% of their final height until the fifth year (data not shown).

Central Leader trees had the largest canopy spread at the conclusion of the trial (Table 1). However, for four of the last six years of the trial there was no significant difference in canopy spread between the two pruning systems (data not shown). Trees on Haggith rootstock had the greatest canopy spread and there were no differences between M800 and Yuksa. This

Table 1. Tree height, spread and trunk cross-sectional area (TCA) of 'Sundrop' apricot in year 10 (2000) for trees trained to Central Leader or Spanish Bush and on three rootstocks, Haggith, M800, and Yuksa. All values are Least Square means, adjusted for missing observations.

Treatments	Tree height (m)	Tree spread (m)	TCA (cm^2)
Pruning			
Central Leader	5.02 a[Z]	4.47 a	222.9 a
Spanish Bush	2.96 b	4.28 b	226.9 a
Rootstocks			
Haggith	4.41 a	4.98 a	294.1 a
M800	3.95 a	3.97 b	143.6 c
Yuksa	3.96 a	4.19 b	227.0 b
Statistics (p-value)			
Pruning	0.0002	0.0396	0.8758
Rootstock	0.0975	<0.0001	<0.0001
Interaction	0.0190	0.2797	0.7845

[Z]LS means in columns within groups not followed by a common letter are significantly different (P≤0.05).

was consistent from the fifth year after planting until the end of the trial.

Pruning system had no effect on TCA even though tree height and canopy spread were affected by pruning (Table 1). In contrast, rootstock significantly affected the TCA; Haggith trees had the largest TCA followed by Yuksa, and M800. The TCA of trees on Haggith was more than twice the size of trees on M800 rootstock. There were significant differences among rootstocks beginning the fall of the year of planting (Fig. 1). TCA measurements were not taken at planting. Yuksa had the largest TCA until 1995; subsequently Haggith had the largest TCA until the end of the trial.

Fruiting. All treatments began to crop in 1992, the year after planting (Fig. 2). There was no effect due to training system on when fruiting began. In 1993 M800 had the lowest yield and consistently had the lowest yield for the remaining years of the trial. The general reduction in yield for all trees in 1998 (Fig. 2) was likely due to the low spring temperatures during bloom. There were five days during the apricot bloom period when the minimum temperatures were below 0°C. Pruning system did not significantly affect cumulative yield (Table 3). Trees on Haggith had a significantly higher cumulative yield than M800 and Yuksa was intermediate.

Table 2. Interaction means for final tree height (2000) of 'Sundrop' apricot trees pruned to Central Leader or Spanish Bush. All values are Least Square means, adjusted for missing values.

Pruning treatment	Tree height (m)
Central leader	
Haggith	5.69 a[Z]
M800	4.53 b
Yuksa	4.85 b
Spanish Bush	
Haggith	2.78 c
M800	3.03 c
Yuksa	3.07 c

[Z]LS means not followed by a commom letter are significantly different (P≤0.05).

Average weight of fruit from CL trees was significantly higher than that of fruit from the SB trees in seven of the nine years (missing data from 1994) (data not shown). In the other two years there were no significant differences. This is reflected in the overall average fruit weight (Table 3). Fruit from trees on Haggith were larger over the length of the trial than fruit from trees on M800 or Yuksa. Fruit from trees on M800 were consistently smaller than fruit from Haggith when there were significant differences. Fruit from Yuksa were intermediate in size or similar to M800.

Discussion

The SB pruning system reduced the height of the tree by about 2 m. A tree height of 3 m allows much of the work, such as pruning, thinning, and harvesting

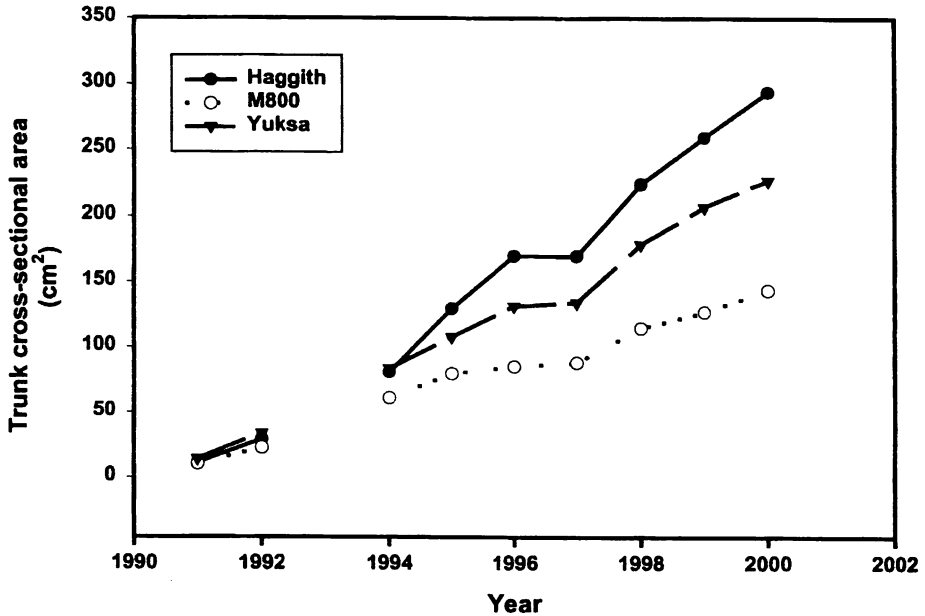

Fig. 1. Annual trunk cross-sectional area of 'Sundrop' apricot trees on Haggith, M800 or Yuksa rootstock, 1991 to 2000. Trees planted in 1991.

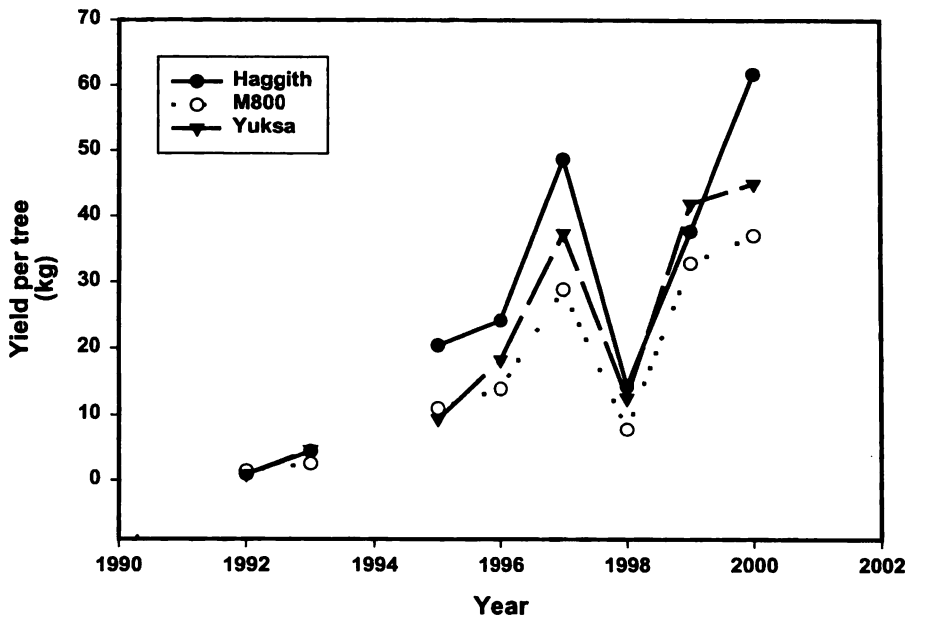

Fig. 2. Annual yield of 'Sundrop' apricot trees on Haggith, M800, or Yuksa rootstock, 1992 to 2000 (no yield data in 1994).

Table 3. Mean cumulative yield (8 years) and average fruit weight of 'Sundrop' apricot trees trained to Central Leader or Spanish bush on three rootstocks: Haggith, M800, and Yuksa. All values are Least Square means, adjusted for missing values.

Treatment	Cumulative yield (1992 to 2000)[Z] (kg)	Average fruit weight (g)
Pruning		
Central Leader	175.4 a[Y]	57.8 a
Spanish bush	173.6 a	49.7 b
Rootstocks		
Haggith	212.7 a	59.0 a
M800	137.3 b	49.6 b
Yuksa	170.2 ab	52.6 b
Statistics (p-value)		
Pruning	0.8541	0.0011
Rootstock	<0.0001	0.0021
Interaction	0.2579	0.2199

[Z]Yield for 1994 missing.
[Y]LSmeans within groups not followed by a common letter are significantly different (P≤0.05).

to be done from the ground or from a small ladder or step stool. Even though the spread of the canopy of the trees in this study was statistically smaller for the SB, it would not allow for a large increase in planting density. Increasing planting density has been shown to have a significant effect on total yields in tree fruit crops (7, 14). No attempt was made in this trial to determine the differences in labor requirements because the numbers of trees were too few to get meaningful data. Summer pruning is an additional requirement with the SB system (but not of the CL system) that would increase labor requirements; however, SB trees appeared to require less dormant pruning time in the early years, which would have a compensatory effect. The CL system, because of its height, may require that more work be done from ladders, which tends to be inefficient.

Pruning did not cause a difference in yield over the life of the trial but did result in a reduction of fruit size for fruit from SB pruned trees. This reduction may not be significant for growers in most years because the reduction only averaged 8 g. The reduction in fruit size on SB trees is of interest given that the fruit was hand thinned to the same level. It is possible that the summer pruning of the SB trees may have altered the supply of carbohydrates to the fruit.

The M800 rootstock significantly reduced tree size. Trees on M800 were about 50 cm shorter with a canopy spread 1 m less than trees on Haggith. This reduction in tree size would allow an increase in tree planting density; it is unknown if the increased tree density would compensate for the reduced yield of the trees on M800. Fruit from trees on M800 were also significantly smaller. An additional concern is that the trees on M800 suffered a slow decline over the trial and progressively looked less healthy each year. The cause of this decline is unknown. It may have been incompatibility, as previously reported for apricot scions and non-apricot rootstocks (1).

In conclusion, it appears that the SB system could be a suitable pruning system for apricots. Possibly more fruit must be removed during fruit thinning to ensure that there is not a reduction in fruit size. The uncertainty of M800 compatibility does not allow for its recommendation as a rootstock for apricot. Yuksa did not appear to have the same problems as M800, but results in this study suggest there is no advantage for its use over Haggith. Haggith remains the rootstock of choice for northern apricot fruit growing regions.

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Two Reviews on Currants (*Ribes rubrum*)

Small Fruits Review
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This issue of Small Fruits Review includes the following two reviews, both prepared by K. Kampuss from Latvia and H. L. Pedersen from Denmark.

A Review of Red and White Currant (*Ribes rubrum*): Research and Literature. pp 23-46.

A Review of Red and White Currant Cultivars. pp 47-102.

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