Potential for Cherry Rootstocks

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Historically, the mazzard rootstock has been the rootstock of choice for growers in the Pacific Northwest. For the most part, our soils in The Dalles are moderately light loess soils, most of them being loamy in nature, with a range from sandy loam to clay loam. Most of our soils are deep and correspondingly vigorous. On these soils, mazzard trees grow very quickly, are extremely non-precocious, and are very big. It is for these reasons that growers in the Mid-Columbia region of Oregon, which includes The Dalles and Hood River, have shown an increasing interest in precocious and dwarfing rootstocks.

In fact, in the Mid-Columbia there has been, in recent years, a dramatic shift away from the mazzard rootstock. This is a trend that is probably greater in Oregon than in other parts of the United States. Estimates given by nursery representatives show this trend very clearly (Table 1).

Table 1. Estimated sales of cherry trees on various rootstocks in the Mid-Columbia region of Oregon

Rootstock	Estimated % trees sold 1990	% trees sold 1998	Estimated % trees sold 2001
Mazzard	100	71	40
Gisela 5		19.2	10
Weiroot 158		3.6	
Gisela 7		3.3	
Gisela 6		2.9	50

Data by F. Niederholzer and L. Long

There are a number of reasons for this interest in precocious rootstocks in the Mid-Columbia, not the least of which is economic. In Figure 1 (personal communication C. Seavert) the cost and return received from two orchards is compared. The first is a standard density orchard of 15 x 18 feet on mazzard rootstock and the second is a high-density orchard of 10 x 16 feet on Gisela rootstock. There are two sets of lines. Cash flow represents out of pocket expenses. These are the expenses that most growers consider when they establish and manage an orchard including planting costs, labor, fertilizer, chemicals and harvest costs. However, the economic costs are the true costs of establishing and running an orchard and include interests costs, depreciation and return on investments. It is obvious that the Gisela block will pay back expenses much more rapidly then the mazzard block. Even when looking at the economic costs, it is possible to turn a profit in eight years with a high density Gisela block compared to the 15 years with a standard density orchard on mazzard rootstock.

Figure 1. Comparing the Economic and Cash Costs to Establish a Standard and High Density Sweet Cherry Orchard in Wasco County, Oregon.

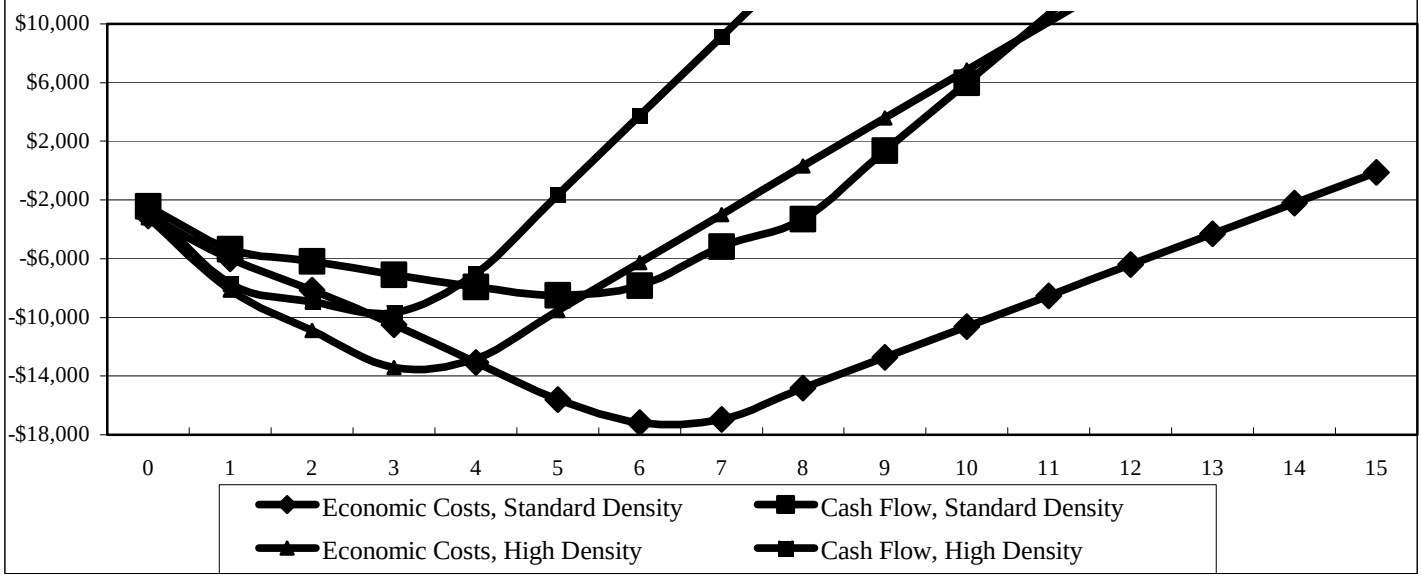

Chart by Clark Seavert

Besides economic reasons, growers are interested in precocious rootstocks to help reduce labor needs. Many of the dwarfing rootstocks are being grown with alternative training systems. Instead of the open vase system that produces large trees, more and more growers are using systems such as the Spanish Bush system or the Central Leader system, which can be maintained at 8 and 10 feet respectively. Using these systems, growers have been able to prune an acre of orchard in half the time of a standard system on full size rootstock and cut the harvest time in half as well. This helps to address our concern of future labor shortages.

Precocious/Dwarfing Rootstocks

The issue of precocious/dwarfing rootstocks has been one of interest in the Pacific Northwest cherry industry for many years. Oregon State and Washington State Universities and the research center at Summerland have been actively testing rootstocks such as Gisela 5 since the late 1980's and other rootstocks such as the M x M series prior to that time. It seemed that early results indicated that there was a direct relationship between tree and fruit size. Trees on dwarfing rootstock produced small fruit, a fatal flaw. However, the Gisela rootstock series out of Germany began to show promise for precocity, some tree size control and large fruit. By the late 1990's scientists from the Pacific Northwest had enough confidence in three of these rootstocks, Gisela 5, 6 and 12 to recommend them to growers for limited plantings and trials.

In the ten years that these rootstocks were tested by OSU and WSU scientists they consistently performed well in The Dalles, Oregon and Prosser, Washington. The most important attributes tested for, in order of importance, were fruit size, precocity and tree size. Finally, it was determined that rootstocks needed to show resistance to two of our most common viruses, prune dwarf (PDV) and Prunus necrotic ringspot virus (PNRSV).

Gisela 5, 6 and 12

All three of these rootstocks are precocious, producing fruit by the third leaf, a tremendous financial advantage over mazzard. Fruit size is equal to mazzard when trees are pruned properly. Depending on the variety and location, tree height for Gisela 5 is 50-70% the size of mazzard while Gisela 6 and 12 will grow 70-90% the size of mazzard. Branch angles are generally wider than with mazzard even with the more upright varieties such as Lapins. Trees infected with two common cherry viruses, PDV and PNRSV survived and continued to produce, however recent follow-ups on earlier tests indicate that Gisela 5 shows slight sensitivity to these viruses. In addition, increased management skills, including more severe pruning will be necessary to maintain fruit size on all three of the rootstocks. Oversetting can be a problem in some years, especially with self-fertile varieties such as 'Lapins' and 'Sweetheart'. Summarized in Table two is a compilation of three years of data on Gisela 5,6 and 12 from a trial in The Dalles. It is apparent that fruit size can be maintained on properly managed trees with self-sterile varieties such as 'Bing'.

Table 2. A compilation of fruit size and tree yield on 4th through 6th leaf 'Bing' trees grown on several rootstocks in The Dalles.

			Average percent fruit size			
Rootstock	**6th leaf trunk area cm^2**	**Cumulative Yield Kg/tree**	**20mm**	**22mm**	**24mm**	**26mm+**
Mazzard	152.3	35.3	1.4	22.2	32.0	44.4
Gisela 5	93.2	49.9	1.4	19.1	30.3	49.2
Gisela 6	156.9	56.8	0.4	15.2	36.3	48.2
Gisela 12	114.5	57.2	0.9	17.3	33.7	48.1

Data by T. Facteau

One of the things that we have noticed is that rootstocks perform differently in different regions. This is why it is important to test rootstocks under local conditions and not to rely on data from other regions such as that listed in Table two. For example, Gisela 6 typically grows to 60% the size of mazzard in test plots in the eastern United States. It is obviously a much bigger tree in the Pacific Northwest. Nevertheless, we find it to be a much friendlier tree to grow than mazzard and although the data would indicate that the trunk size approaches that of mazzard the tree height is significantly smaller than mazzard. In addition, it is a much easier tree to control through pruning than mazzard, making it possible to keep the tree as much as 50% the size of mazzard, if desired.

Another critical consideration is variety/rootstock combinations. Rootstocks will perform much differently with different variety combinations. In the Pacific Northwest we have tested all the rootstocks with 'Bing' as the scion. Combining rootstocks with self-fertile varieties such as 'Sweetheart' can make major changes in rootstock attributes. For example, 'Sweetheart' on Gisela 6 grows a very moderate size tree that is easy to control but readily oversets and produces small fruit if not properly managed. For this reason, I would not recommend Gisela 5 with self-fertile varieties. Due to the heavy setting

potential of self-fertile varieties a combination with Gisela 5 would produce a very non-vigorous tree with heavy crops of small cherries. Due to the interest in self-fertile varieties in the Okanagan, this all but eliminates Gisela 5 as a viable alternative for most plantings in the Okanagan area of Canada.

Besides variety combinations, growers must also evaluate their soil before deciding on a rootstock. Most soils in the Mid-Columbia region of Oregon are deep loess soils that tend to produce vigorous tree growth. A rootstock such as Gisela 5 grows well under these conditions. However, on poorer soils trees lack vigor, they do not branch well and fruit size tends to be small. Typically, soils in the Okanagan are poorer than Mid-Columbia soils and for this reason Gisela 5 may not be a good choice for Okanagan growers.

With your poorer soils and the self-fertile scion combinations that you are interested in making I would tend to encourage you to look at some of the more vigorous rootstocks. Besides Gisela 5, this probably eliminates such rootstocks as Edabriz, Weiroot 72 and 53. In fact, I would tend to eliminate from consideration all Weiroot rootstocks due to their tendency to sprout root suckers.

Gisela 6 would be one of the first rootstocks that I would consider. Gisela 6 is the most readily available precocious rootstock and it has produced good quality fruit in a small demonstration trial with 'Sweetheart' that I planted in 1994 (see table 3).

Table 3. 4th leaf training system trial with 'Sweetheart' cherry, The Dalles.

Training system	**Rootstock**	**Yield/tree (lb.)**	**Fruit wt.**
Vogel Spindle	Gisela 6	63.6	8.92
Open Vase	Gisela 6	35.3	8.47
Spanish Bush	Gisela 6	40.2	8.41
Spanish Bush	Mazzard	7.0	8.40

Data by L. Long

Although Gisela 6 is nearly a full size rootstock with 'Bing' as the scion it appears to be more size controlling with 'Sweetheart'. With the 'Sweetheart'/Gisela 6 combination we have been able to maintain tree height at 8 feet with the Spanish Bush system and 10-11 feet with the Vogel Spindle. This is a tree combination that is nicely under control. When a heading cut is made the tree gives a measured response. This compares to the 'Sweetheart'/mazzard combination that suckers badly when attempting to control growth through heading cuts.

However, there is still need to be concerned about the productive nature of the 'Sweetheart'/Gisela 6 combination. It was clear by the 5th leaf that there would be a significant tendency to overset unless crop reduction techniques were implemented. Through the 7th leaf, crop reduction techniques consisted of making heading cuts into one year old and older wood to maintain tree vigor and reduce crop load. Presumably, if one can maintain tree vigor it will be possible to maintain fruit size.

Tree vigor can be encouraged in two ways. The first is to maintain an adequate level of fertilization as soon as the trees begin to produce. In Oregon we recommend two applications of a nitrogen fertilizer at 50 lb/acre at bud break and a month later. Secondly, it is important to dormant rather than summer prune. To properly prune a tree on Gisela rootstock it is necessary to make numerous heading cuts, both into last seasons wood, as well as a percentage of older wood. It is important to make cuts into older wood to renew the wood and keep it young, but there needs to be a balance since the largest and firmest cherries are produced at the base of last years growth. Cutting too frequently into older wood will reduce the potential for this quality fruit.

Although these fertilization and pruning practices were followed, the 'Sweetheart'/Gisela 6 combination proved to be too productive to control fruit size through these techniques alone. Table 4 shows these data.

Table 4. 'Sweetheart' fruit weight on various training system/rootstock combinations in the 7th leaf after heavy pruning, The Dalles.

Training system	**Rootstock**	**Fruit wt.**
Vogel Spindle	Gisela 6	9.0
Spanish Bush	Gisela 6	8.9
Spanish Bush	Mazzard	10.2

Data by Núñez, Long and Cahn

By the 8th leaf we decided to combine heading cuts with a simple spur thinning technique. We removed approximately 40-50% of the spurs by simply running our loppers on the top and bottom of branches of 'Sweetheart'/ Gisela 6 trees. This technique took only two minutes per tree to accomplish. Table 5 shows that we were able to get good fruit size with this technique, but fruit on the mazzard rootstock still produced the larger fruit.

Table 5. 'Sweetheart' fruit size after removing approximately 40-50% of the spurs on 8th leaf trees, The Dalles.

Rootstock	**% 9 row and larger**	**% 8 row and larger**
Gisela 6	76	4
Mazzard	80	28

Data by Núñez, Long and Cahn

Research on fruit thinning by French scientists indicated that the effects of spur thinning would last for more than one year so we decided not to repeat the process in the 9th leaf. However, by bloom it was obvious that some kind of crop reduction technique, besides the dormant pruning that we had already done, would be needed to reduce crop load and maintain tree vigor. For this reason we thinned the crop by hand in mid-May. Since these were relatively small trees this was easy to do and the task took only 7.5 minutes per tree. Although it takes extra time and money to spur thin or hand thin the crop it must be remembered that it is taking much less time to prune an acre of these trees on size controlling rootstock compared to a standard tree of the same age. Table 6 shows the results of this technique.

Table 6. 'Sweetheart' fruit size after fruit thinning on 9th leaf trees, The Dalles.

Rootstock	% 10 row and larger	% 9 row and larger
Gisela 6	96	54
Mazzard	94	76

Data by Núñez, Long and Cahn

Although we obtained good fruit size with a packout of 84% 9 ½ row, fruit with the 'Sweetheart'/Gisela 6 combination was still smaller than fruit on mazzard rootstock. Even though the Gisela 6 fruit size was smaller in 2002 I am confident that we can find the right balance of crop load and fruit size. Although fruit was thinned in 2002, the crop was still over-set, presumably detrimentally affecting fruit size. This being the case, I believe that a self-fertile variety on Gisela 6 rootstock is a viable combination especially if some chemical means of thinning can be found.

Other Precocious Rootstocks

With self-fertile varieties, however, it may be advantageous to find a more moderately productive rootstock. We have been looking at two rootstocks of moderate productivity that may have a place with 'Bing' or even self-fertile varieties. I am particularly excited about a Mahaleb rootstock out of France called Pontaleb. It is not size controlling but does provide moderate precocity with good fruit size. The second rootstock, Maxma 14, may not be as promising for self-fertile varieties as Pontaleb, but does demand closer attention. Table 7 provides data from 5th leaf 'Bing' trees.

Table 7. Vigor, yield and fruit size of 'Bing' on various rootstocks, The Dalles.

Rootstock	TCSA (cm^2)	Lbs/tree	Fruit diam. (mm)
Maxma 14	160.7 b	46.0 a	27.2 b
Edabriz	63.2 c	36.8 ab	25.4 c
Pontaleb	156.3 b	27.6 b	28.3 a
Mazzard	148.5 b	2.8 c	27.7 ab

Mean separation by SAS LSMeans procedure ($P < 0.05$).

Data by Núñez, Long and Cahn

It is obvious that there are difficulties that need to be overcome when growing self-fertile varieties on dwarfing and/or precocious rootstocks. There are some growers in the Mid-Columbia that have accepted the challenge of growing self-fertile varieties on such rootstocks as Gisela 5 and 6, and have done very well. The most successful of these orchards are south of Hood River, where growers often receive up to $1.50 U.S. per pound for their Lapins. However, due to the special challenges incumbent in growing self-fertile varieties with productive rootstocks most of our growers prefer growing the self-fertile varieties on mazzard rootstock. These growers have chosen to work with mazzard rootstock, attempting to overcome some of its weaknesses, the greatest of which is precocity.

Increasing the Precocity of Mazzard

Growers in the Mid-Columbia have adopted several techniques to try to increase the precocity of mazzard, thereby making it more profitable. New orchards on mazzard rootstock are being planted approximately 12 ft. x 18 ft. Trees are often summer pruned to increase precocity and reduce vigor. The training system of choice is the Steep Leader an adaptation of the open vase. Growers believe that they will be able to maintain tree integrity at this spacing even with this rootstock and training system combination.

Although higher density plantings may help to moderately increase early per acre yields they do not correct the lack of precocity inherent in the mazzard rootstock. Besides summer pruning, growers are addressing the issue of precocity in other ways. It is widely known that pruning a young cherry tree will stimulate new growth and prolong its vegetative state. Conversely, if juvenile cherry trees are minimally pruned they will fruit at a younger age. Since 'Bing' and most other varieties do not readily branch, simply not pruning a tree is not the answer. For years, growers have been looking for ways of obtaining branching without pruning and thereby encourage precocity.

Initially, growers in California and the Pacific Northwest experimented with Promalin to obtain branching without pruning and thereby achieve the goal of earlier production. Table 8 shows the effect of a Promalin treatment on Central Leader 'Lapins' trees on Gisela 11 rootstock (personal communication T. Facteau).

Table 8. Effect of Promalin on yield of Central Leader 'Lapins' trees on Gisela 11 rootstock planted in 1996.

	Kg/tree		
	1998	1999	2000
Central leader, Vogel	0.16	14.51	20.1
Central leader, Promalin	0.61	23.0	20.3
LSD, 5%	0.22	2.8	NS

In this experiment, Promalin increased precocity for the first two years of production. By year 3, or the 5th leaf, there were no differences between treatments. Although, effective at increasing early yields when it induced branching, growers in the Pacific Northwest soon discovered that Promalin did not work consistently enough to rely on year after year and therefore began looking for other techniques to promote branching without pruning. For this reason bud scoring has recently gained popularity. Growers have found this method to be useful and more reliably successful. Table 9 (personal communication T. Facteau) gives the results of a trial designed to investigate the differences between tools used for scoring and scoring dates. The double blade tool had two parallel blades that removed a section of bark 5 mm wide. The grape tool was a blade used for scoring grapes that removed a section of bark 6 mm wide and the saw blade was from a Leatherman tool.

Table 9. Effect of scoring tool and date on branch formation of 'Bing'/mazzard trees

Scoring tool	**Scoring date**	**# of limbs scored**	**Scored buds/limb**	**Scored buds forming**

				branches(%)
Double blade		20	14.9	59.2
Grape tool		20	13.4	57.7
Saw		19	14.2	67.9
	3/9 (dormant)	14	12.9	63.6 a
	3/21 (green tip)	15	13.3	75.6 a
	4/7	15	14.7	73.2 a
	4/17 (leaves present)	15	15.7	28.9 b

Means followed by the same letter are not statistically different
Data by T. Facteau

Scoring notches need to be made immediately above a bud and penetrate to the cambium. Several tools can be used to make this cut and a wide range of treatment dates around bud break will give successful results. The 21 March treatment corresponds to bud break. Branching decreased significantly by the time the trees began to leaf out on 17 April. The main concern with scoring is the increased potential for bacterial canker (*Pseudomonas syringae*) infection. It is suggested that scoring cuts be treated with a copper spray immediately after treatment. Wood up to four years old has been scored successfully. With this treatment it is possible to completely establish the structure of a tree with no heading cuts.

Summary

Growers in the Mid-Columbia have used both precocious/dwarfing rootstocks and training techniques with mazzard rootstocks to increase the precocity of both self-fertile and self-sterile varieties. Both are viable options that can prove profitable, but both have inherent challenges associated with them. Growers need to evaluate their management skills, soils and variety options before making an informed decision about rootstock selection.

References

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