TABLE 1: SWEET CHERRY COMPATIBILITY AND BLOOM TIMING

Compatibility	Pollination Period				
Group*	**I**	**II**	**III**	**IV**	**V**
Group I (S_1S_2)	Black Tartarian	Tulare SMS 33		Summit	
Group II (S_1S_3)	Samba (Sumste)	Helga Simcoe (PC 7147-1) SPC335 CoralChampagne	Early Robin Justyna Satin (Sumele) Van	Areko Cristalina (Sumnue) Olympus Sonnet	Regina
Group III (S_3S_4)	Somerset	Burgundy Pearl Jacinta Sandra Sweetheart SMS 311	Bing Emperor Sir Douglas NY 13696 (S_3S_4)? NY 13788 (S_3S_4)? NY 13791 (S_3S_4)?	Amid	Napoleon Ulster
Group IV (S_2S_3)		Vega	Bigalise (Enjidel) Coralise	Dame Nancy	
Group V (S_4S_5)		Tim			
Group VI (S_3S_6)	Burgsdorf (Self fertile?)	Christiana Hartland		Kordia (Attika) Starks Gold	Cristobalina
Group VII (S_3S_5)					Hedelfingen
Group VIII (S_2S_5)			Vista		
Group IX (S_1S_4)	Frisco	BF-9 Summer Jewel Black Pearl Tubbel	Ebony Pearl Rainier	Sylvia	Hudson
Group XIII (S_2S_4)			Royalton	Sam Vic	Sam Suite Note (SPC136)
Group XIV (S_1S_5)		Rons Seedling	SPC342		
Group XVI (S_3S_9)	SMS 1 SMS 6	Burlat Chelan	Tieton Early Burlat		
Group XVII (S_4S_6)					Irena
Group XVIII (S_1S_9)	Brooks	Bellise (Bedel) Earlise (Rivedel)	Rocket Australise (Arodel)		
Group XX (S_1S_6)	Empress				Elza Fabiola
Group XXI (S_4S_9)	Merchant SMS 290 (Nimba)			Kiona (PC 8007-2)	
Group XXII (S_3S_{12})				Nordwunder (S_3S_4)?	Schneiders 0900 Zirat
Group XXV (S_2S_6)				Early Korvik	
Group XXXVII (S_5S_9)				Cowiche (PC7903-2)	
Group XLV (S_4S_{13})					
Group LI (S_1S_{13})		Radiance Pearl	Black Douglas		
Unknown Groups & S-alleles	NY 412068	NY 564 Supreme	PC 7064-3 PC 7616-4 NY 270 NY 2131 NY 7690 NY 9801 NY 413087 NY 414205	PC 7309-4 PC 8007-2 PC 8008-1 NY 410213 NY 412113 NY 9295	PC 7636-1 St Margaret
Self-fertile with S_4' allele (universal donors)		BF-9 (S_1S_4') Index (S_3S_4') Lapins (S_1S_4') Marble (S1S4') Marysa (S_3S_4') (PA6UNIBO) Simone Sir Don ($S_4'S_{13}$) Sir Tom (S_4S_{13}) SMS 16 (S_1S_4') SPC243 (S_4',nd)	Celeste (S_1S_4') Glacier ($S_4'S_9$) Santina (S_1S_4') Selah (S_3S_4') Staccato (S_3S_4') Starkcrimson (S_3S_4') Stella (S_3S_4') Sunburst (S_3S_4') Sweetheart (S_3S_4') Symphony (S_1S_4') SPC234 (S_1S_4') SPC106/Sofia (S_2S_4') SPC276 (S_3S_4')	Cashmere ($S_4'S_9$) Sandra Rose (S_3S_4') Sentennial (S_3S_4') Skeena (S_1S_4') Sonata (S_3S_4') Sovereign (S_3S_4') Starblush (S_3S_4') White Gold (S_3S_4') Sir Hans (S_2S_4') SPC411 (S_3S_4') SPC414 (S_1S_4') SPC424 (S_3S_4')	Benton ($S_4'S_9$) Black Gold ($S_4'S_6$) Dame Roma ($S_4'S_{13}$) Felicita ($S_4'S_9$) Stardust (S_1S_4')

*Self-sterile cultivars require a pollinizer which must be from a different compatibility group and must bloom at the same time in order for pollination to take place. Self-fertile cultivars can be pollinated with their own pollen and consequently do not need a pollinizer cultivar.

What are S-alleles and other pollination questions?

For cherry trees to have a plentiful crop the flowers must be pollinated with compatible pollen, the pollen must then grow down the pistil (stigma and style) and fertilize the "egg" or ovule in the ovary. Difficulties can arise at any of the steps in the process which can affect the outcome and result in reduced fruit set. This article briefly summarizes the cherry pollination process and provides a few suggestions to ensure adequate pollination and fruit set.

The first step in the process is the transfer of compatible pollen from a pollinizing variety to a receptive stigma. Bees are the predominate pollinators in cherry orchards however other insects are also involved to some degree. Most sweet cherry varieties are self incompatible and the majority are also incompatible with other varieties within the same incompatibility group. Over the years sweet cherry varieties with the same S-alleles have been placed in compatibility groups. Varieties within groups are not only self-incompatible they are also incompatible with other varieties within the group.

For example, Cristalina and Van are both in Group II and therefore cannot be used to pollinate themselves or each other. On the other hand all varieties in one group are compatible with varieties in another group.

Compatibility groups are listed below.

Therefore, with traditional self-incompatible varieties a second pollinizing variety needs to be planted within the orchard and you must ensure that not only are they compatible but that the flowering period overlaps. This can be difficult if the bloom period is very early or very late. With the release of Stella in 1968 the first self-fertile variety with a reasonable level of fruit quality was available for growers. This then provided the possibility for single variety orchards and a more consistent cropping pattern. These self-fertile varieties are also able to pollinate other varieties as long as their bloom periods overlapped.

Parts of a cherry flower: (from: www.ualr.edu/botany)

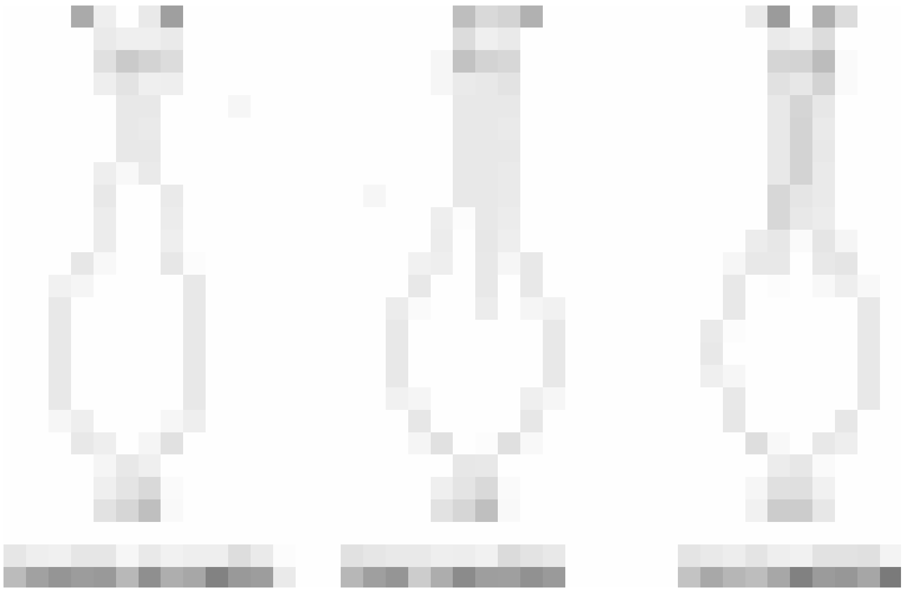
For sweet cherries, pollen compatibility is controlled by a single genetic locus with many alleles (S-alleles) and these have been named S1, S2, S3, etc. Pollen will contain one of the S-alleles whereas the tissue of the pistil will have two S-alleles. Pollen with a single S allele in common with either of the S-alleles in the pistil will be rejected by the pistil and unable to grow down the style as in Example A below. This would occur if the pollen came from trees of the same variety or from trees of varieties in the same compatibility group.

Pollen with an S-allele different from the S-alleles of the pistil would be able to grow down the style and have the potential to fertilize the egg.

Example A: Pollen grains with S1 or S2 have landed on a stigma of a flower variety with similar S-alleles (S1S2), either its own pollen or pollen from a variety within the same compatibility group. None of the pollen tubes will grow down the style and fertilize the egg. Therefore, no seeds or fruit will develop.

Example B: Pollen with S1 or S3 has landed on a stigma of a flower variety with S-alleles S1S2. Therefore only the pollen grain with the S3 allele will grow down the style and potentially fertilize the egg.

Example C: Pollen with S3 or S4 has landed on the stigma of a flower variety with S-alleles (S1S2). Therefore, both pollen grains have the potential to grow down the style and fertilize the egg.



A B C

The self-fertile variety Stella has the alleles S3S4' (S-4-prime). Currently all the named self-fertile varieties from the PARC-Summerland breeding program contain the S4' allele along with another S-allele. This allows the S4' pollen to function on its own pistil, that is the pollen tube can grow down the pistil and potentially fertilize the egg. Varieties with the S4' allele can be considered universal pollen donors because they are compatible with other varieties also. However S4 pollen from a self-infertile variety such as Bing is unable to function on a pistil with the S4' allele that is the pollen tube with the S4 allele cannot grow down the pistil with the S4' allele. In this case the pistil with the S4' allele behaves as if it is S4.

Pollen transfer is just one part of the development of seeds and potentially fruit. Once the pollen has landed on the stigma it begins to grow down the style (if compatible) and eventually fertilize the ovule. The rate of pollen growth and ovule longevity can influence seed set. Another important consideration is effective pollination period which is the period of time for pollination to take place and have fruit set occur. Effective pollination period is influenced by temperature and tree nutrient status. Low temperatures will slow the growth of the pollen tube however it may extend the life of the ovule. High temperature can increase the rate of growth of the pollen tube however it may shorten the life of the ovule. Boron, nitrogen and tree carbohydrate status have been implicated in the length of the effective pollination period.

Compatibility Groups of some sweet cherry varieties:

Group I (S_1S_2): Early Rivers, Sparkle, Summit.

Group II (S_1S_3): Cristalina, Olympus, Regina, Samba, Sonnet, Satin, Van, 13N-07-19.

Group III (S_3S_4): Bing, Lambert, Napoleon (Royal Ann), Star.

Group IV (S_2S_3): Sue.

Group VI (S_3S_6): Attica (Kordia).

Group IX (S_1S_4): Chinook, Rainier, Salmo, Summer Jewel, Sylvia, SPC105.

Group XIII (S_2S_4): Sam.

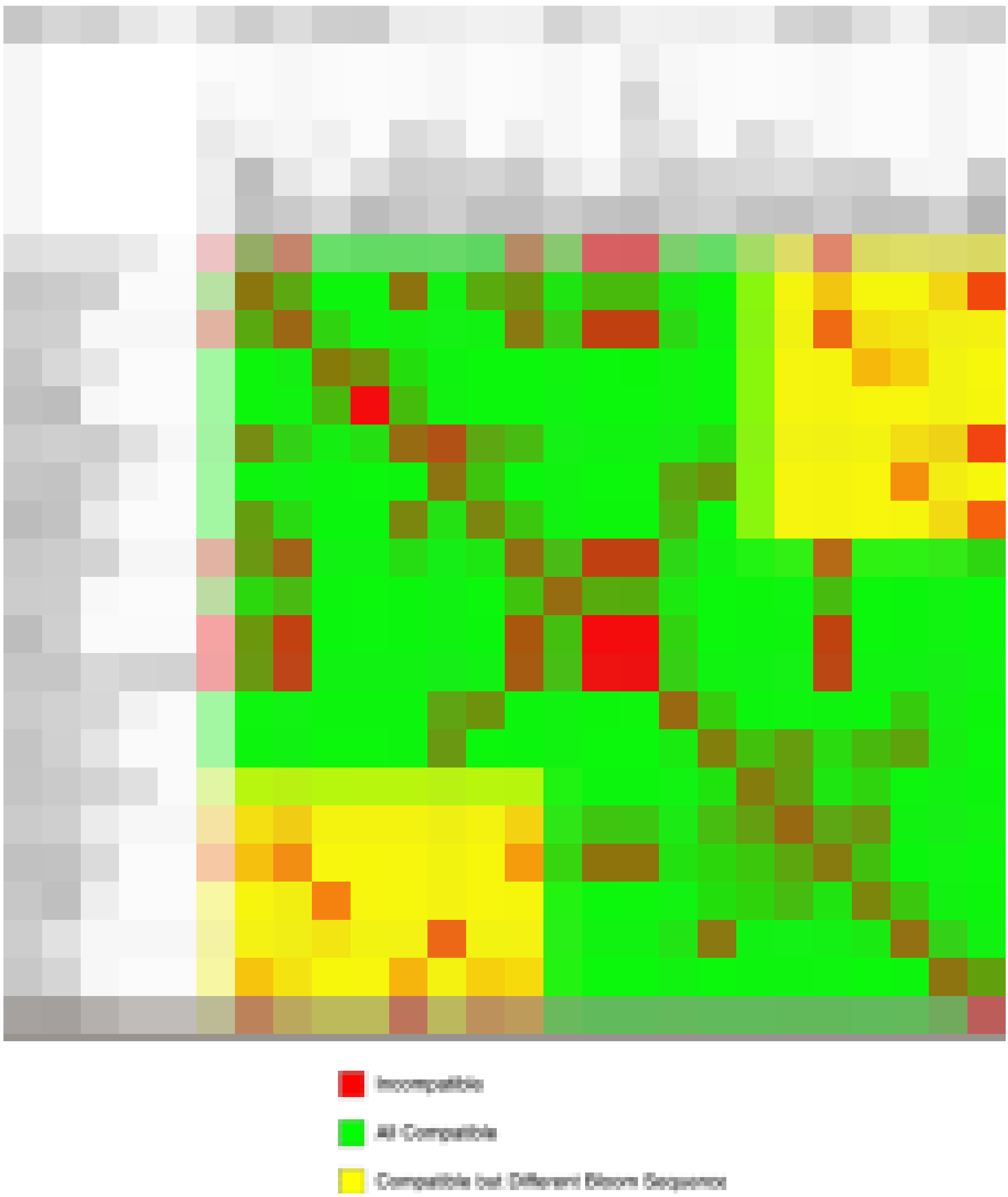
Group XVI (S_3S_9): Burlat, Chelan, Tieton.

Group V (S_4S_5); Group VII (S_3S_5); Group VIII (S_2S_5); Group X (S_6S_9); Group XI (S_2S_7); Group XII (S_6S_{13}); Group XIV (S_1S_5); Group XV (S_5S_6); Group XVII (S_4S_6); Group XVIII (S_1S_9); Group XIX (S_3S_{13}): no varieties of importance to the BC industry.

Further Suggestions

Managing honeybees for pollination: the BCMAFL / BCFGA Tree Fruit Production Guide recommends 3 hives per hectare and to move the hives into the orchard when about 10% of the blossoms are open. Orchard design should ensure adequate number of pollinizers (minimum of about 10% of the trees), compatible varieties, and overlapping bloom periods. Use of bees for self-fertile varieties should also increase fruit set. This is important especially for some self-fertile varieties that appear to have lighter fruit set such as Skeena and 13S-21-01 (Sovereign).

References: Brewer, L. and Azarenko, A. 2003. Fundamentals of flowering and fruit development. In: M. Whiting (ed.) Producing premium cherries. Pacific Northwest Fruit School Cherry Shortcourse Proceedings. Good Fruit Grower, Yakima, Wash., Wiersma, P.A., Wu, Z., Zhou, L., Hampson, C., and Kappel, F. 2001. Identification of new self-incompatibility alleles in sweet cherry (Prunus avium L.) and clarification of incompatibility groups by PCR and sequencing analysis. Theor. Appl. Genet. 102:700-708.



Self-compatibility cultivars

These self-fertile sweet cherries can be used as Universal donors (cross compatible to SI) for self-incompatible sweet cherries if they have synchronous bloom times.

SF Sweet Cherries	Bloom time*
Lapins	Early
Skeena	Early
Sweetheart	Early Mid
Vandalay	Early Mid
WhitegoldTM	Early Mid
Sonata	Mid
Stella	Mid
Symphony	Mid
Tehranivee	Mid
Sunburst	Late Mid
BlackgoldTM	Late

*This bloom time category is based on above self-incompatible sweet cherries.

https://www.slideshare.net/ByronPhillips1/cherry-pollination-final-46501535

Cherry Cross Compatibility

Many sweet cherry cultivars are not able to set a crop through self-pollination. These "self-incompatible" cultivars must be planted with a genetically different cherry cultivar (a pollinizer) that will provide the "compatible" pollen required for fruit set. Other cultivars are self-fertile and do not require a pollinizer.

Genetics

The ability of cherry pollen to grow down the flower style is controlled by the S locus. Each cultivar has two *S*-alleles and each pollen grain carries one of these. Flowers cannot be pollinated by pollen from any source that carries either of those two alleles, including its own. Due to inbreeding in the narrow genepool of North America, many pairs of cultivars share the same two *S*-alleles (same *S*-genotypes) and thus are cross-incompatible. The exception is the S4' allele, which confers self-fertility. Effectively, S4' acts as "stealth pollen" that can pollinate anything including flowers of the cultivar it came from.

Cross-incompatible cultivars with the same S-genotypes are placed in the same "Incompatibility Group" and cannot fertilize each others successfully. For more information on Incompatibility Groups, please see the **functional genotype list** for this DNA test.

Predictive Capacity

This DNA test robustly detects the common *S*-alleles of S1, S2, S3, S4, S4', S5, S6, and S9. Most rare *S*-alleles are not detected and result in null alleles. For example, an S3 | S22 tree would only show the S3 allele with this test. To detect other alleles requires different DNA testing with allele-specific primers.

Although the *S*-genotypes are well known for most sweet cherry cultivars, every new individual created by breeding is a new unknown. *S*-genotypes of new cultivar releases should be determined prior to commercial planting. Before planning crosses, all prospective parents should be S-genotyped to avoid incompatible combinations. The DNA test can also identify self-fertile seedlings within breeding families.

When to Assay: Although the S-genotypes are well known for most sweet cherry cultivars, every new individual created by breeding is a new unknown. S-genotypes of new cultivar releases should be determined prior to commercial planting. Before planning crosses, all prospective parents should be S-genotyped to avoid incompatible combinations. The DNA test can also identify self-fertile seedlings within breeding families.

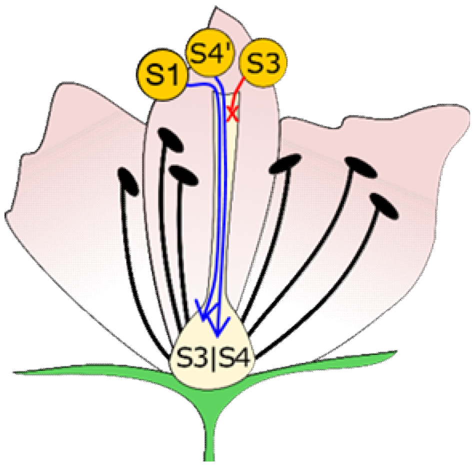
Allelic State of Selected Cultivars

Although dozens of S-alleles are known, some are very common. The S4' allele is increasing in frequency as breeders often strive to develop self-fertile cultivars.

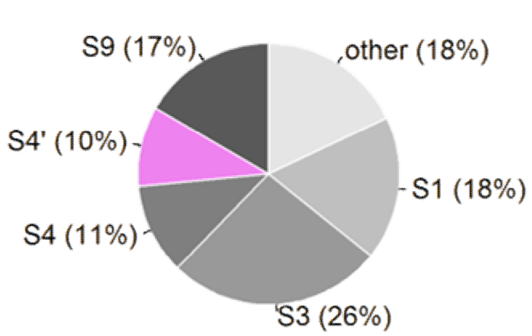
Genotype	Cultivar	Trait
S3|S4	Bing	requires pollinizer
S4'|S9	Glacier	self-fertile
S1|S4'	Lapins	self-fertile
S1|S4	Rainier	requires pollinizer

A table of haplotypes for important U.S. sweet cherry germplasm can be downloaded **here**.

Cross-compatible reaction: Only non-same and S4' pollen can grow down the flower style for successful fertilization and eventually a fruit.



Allele Frequency for U.S. public cultivars: "Other" includes S2, S5, S6 and other rare alleles.



Technical Details: Two simple PCR-based assays are multiplexed in this DNA test: Pav-S-universal that detects all of the common alleles in U.S. germplasm, and Pav-S4'-indel that distinguishes self-fertility-providing S4' from the regular S4.