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		Summit	
Group II (S_1S_3)	Samba		Van Early Robin	Cristalina Olympus Sonnet	Regina
Group III (S_3S_4)	Somerset		Bing Royal Anne (Napolean) Emperor Francis	Lambert	
Group IV (S_2S_3)		Vega			
Group VI (S_3S_6)	Burgsdorf (Self fertile)	Hartland		Kordia Starks Gold	Cristobalina (Self fertile)
Group VII (S_3S_5)					Hedelfingen
Group VIII (S_2S_5)			Vista		
Group IX (S_1S_4)			Rainier Black Republican Bada	Sylvia	Hudson
Group XIII (S_2S_4)	Merchant?		Royalton		Sam
Group XVI (S_3S_9)		Chelan Burlat	Tieton		
Group XXI (S_4S_9)	Merchant?				
Group XXII (S_3S_{12})					Schneiders 0900 Zirat
Unknown Groups & S-allelles	Empress NY 412068	Supreme Rons Seedling Earlise (Rivedel) Simone Summer Jewel PC 7147-1 NY 564	Australise (Arodel) PC 7616-4 Salmo PC 7064-3 NY 9801 Early Burlat NY 7679 NY 7690 Sunburst NY 270 NY 414205 NY 2131 NY 413087	Vic Angela Kristen Nordwunder Sam PC 7309-4 PC 8008-1 NY 410213 NY 412113 PC 8007-2 NY 9295 Kiona (PC 8007-2)	Napoleon St Margaret Ulster PC 7636-1
Group ?? (S_1S_{13})			Black Douglas		
Self-fertile with S_4' allele (universal donors)		Lapins Sweetheart Index Sir Don Sir Tom	Staccato Stella (S_3S_4) Symphony Selah Santina Celeste Glacier Starkcrimson (S_3S_4)? Sir Douglas (S_3S_4) NY 13696 (S_3S_4)? NY 13788 (S_3S_4)? NY 13791 (S_3S_4)?	Skeena Sandra Rose Sonata Cashmere White Gold (NY13688) (S_3S_4) Summit Dame Nancy Sir Hans (S_2S_4)	Stardust Benton Black Gold Dame Roma (S_4S_{13})

*Self-sterile cultivars require a pollinizer. The pollinizer 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?

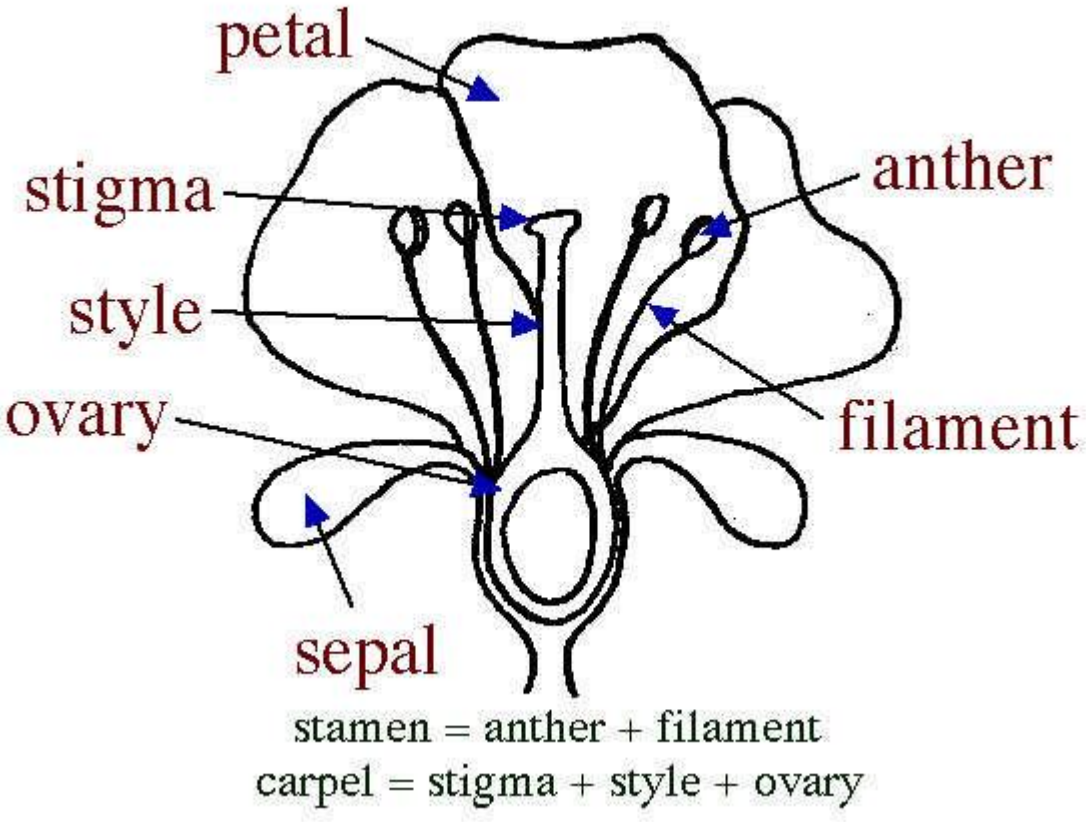
For cherry trees to have a plentiful crop the flowers must be pollinated with compatible pollen; the pollen must then grow down the pistil (stigma and style) and fertilize the “egg” or ovule in the ovary. Difficulties can arise at any of the steps in the process which can affect the outcome and result 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. Also these self-fertile varieties are able to pollinate other varieties as long as their bloom periods overlapped.

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



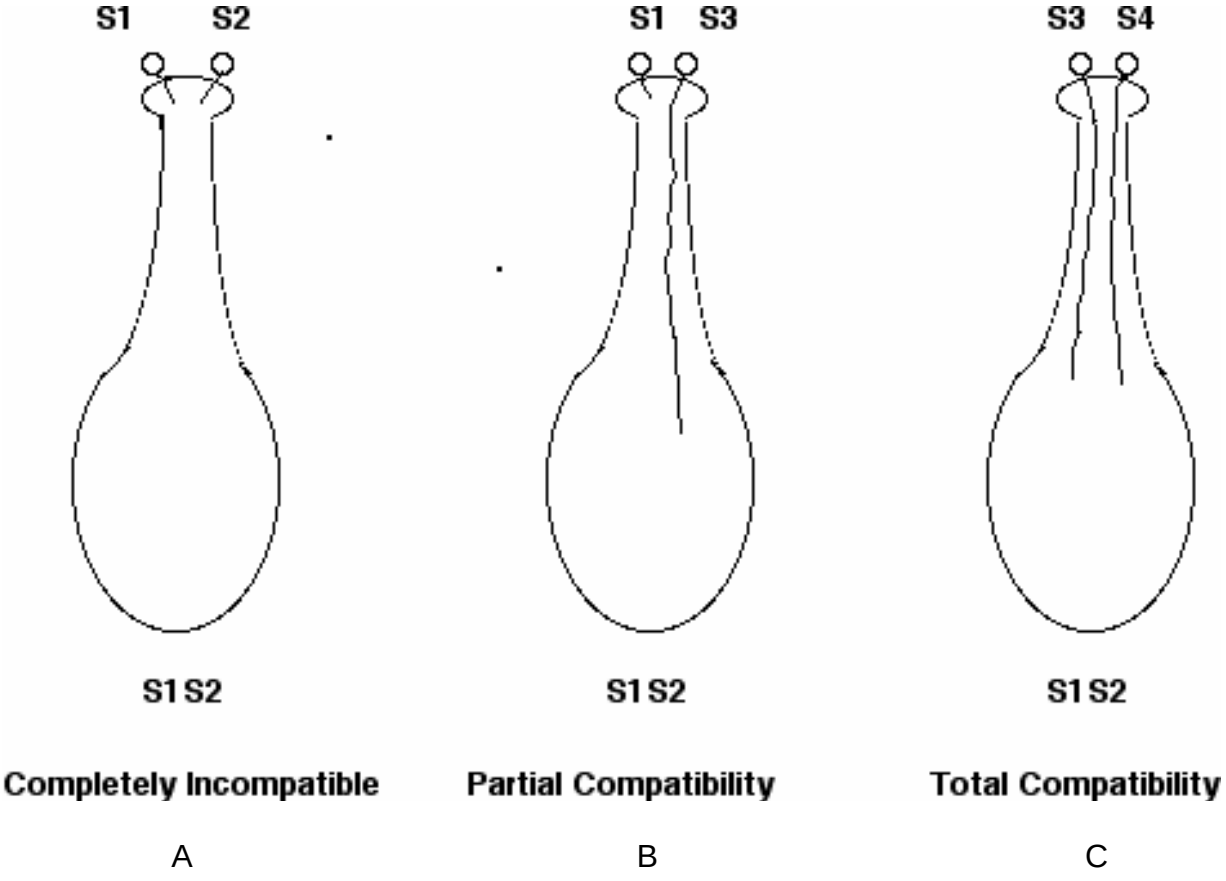
For sweet cherries, pollen compatibility is controlled by a single genetic locus with many alleles (S-alleles) and these have been named S1, S2, S3, etc. Pollen will contain one of the S-alleles whereas the tissue of the pistil will have two S-alleles. Pollen with a single S-allele in common with either 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.



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.

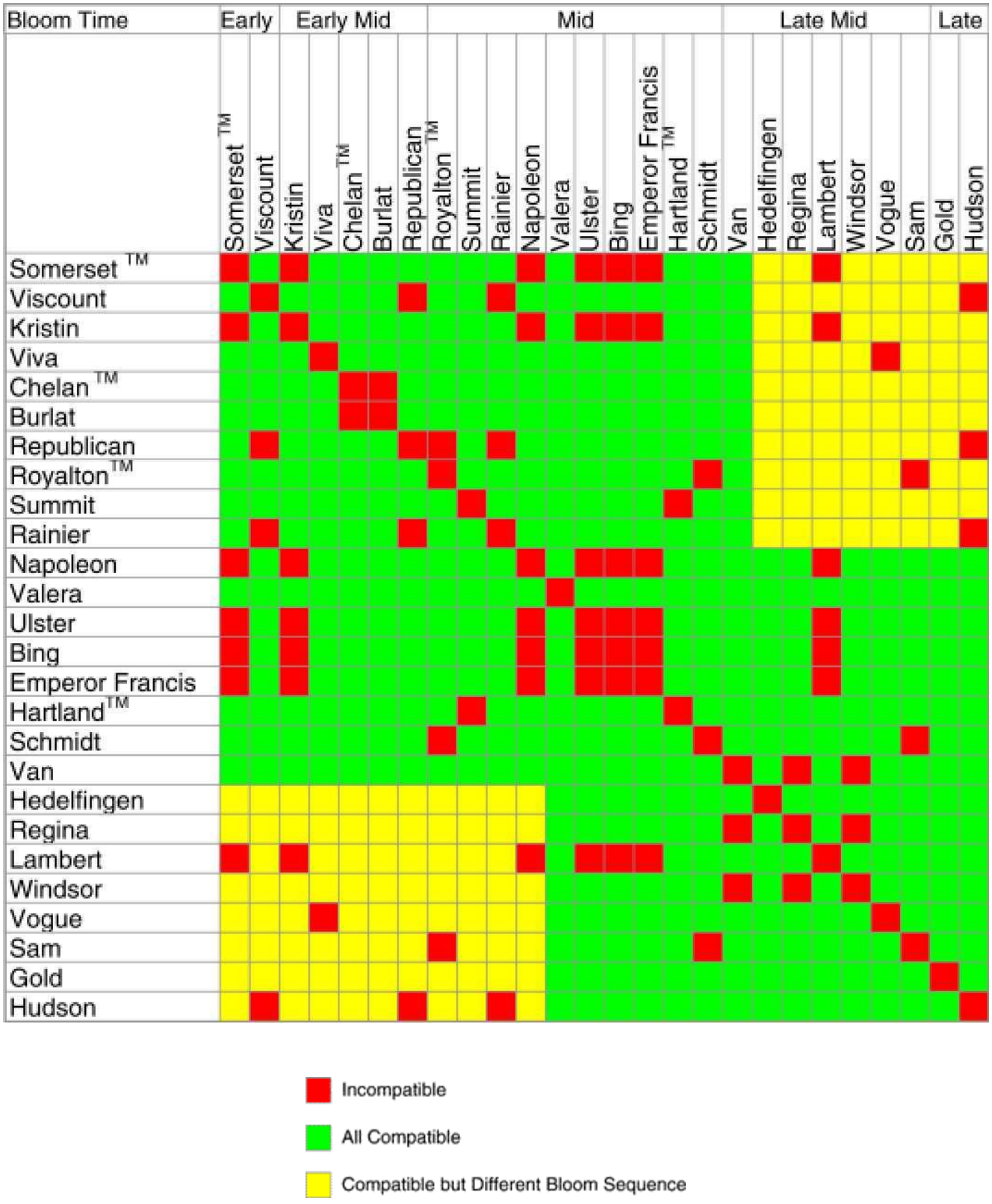
Pollen transfer is just one part of the development of seeds and potentially fruit. Once the pollen has landed on the stigma it begins to grow down the style (if compatible) and eventually fertilize the ovule. The rate of pollen growth and ovule longevity can influence seed set. Another important consideration 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.


Bloom Time
Early
Early Mid
Mid
Late Mid
Late
Somerset™
Viscount
Kristin
Viva
Chelan™
Burlat
Republican
Royalton™
Summit
Rainier
Napoleon
Valera
Ulster
Bing
Emperor Francis
Hartland™
Schmidt
Van
Hedelfingen
Regina
Lambert
Windsor
Vogue
Sam
Gold
Hudson
Incompatible
All Compatible
Compatible but Different Bloom Sequence

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.