# TB Color and Pattern Genetics—Introduction

This is meant to be a simple "crib sheet" describing the most widely understood genes effecting iris colors and patterns. Some of what is stated here is a simplification, and there are exceptions to almost everything. It is intended to be used as a starting point, not to be taken as the final word on any detail. Corrections are welcome, if it appears something here is downright wrong rather than just a simplification.

## Pigment Types

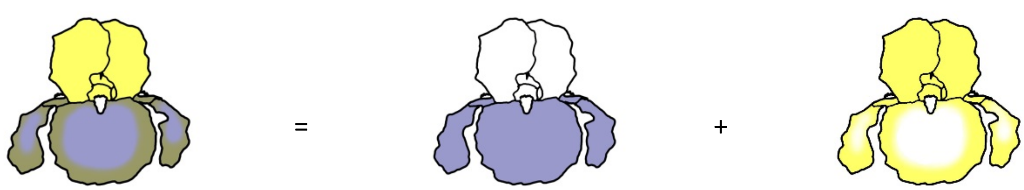
The single most important key to understanding colors and patterns is that there are two different kinds of pigments:

**Anthocyanins** are blue and violet water-soluble pigments found in the cell sap.

**Carotenoids** are yellow and pink fat-soluble pigments found in plastids, small "bubbles" within the cells.

When both anthocyanins and carotenoids are present in the same part of the flower, the visual effect produced may be brown, tan, gray, reddish, or (if the carotenoid is pink) raspberry purple. There are no genes for these colors, they are just a visual illusion caused by the two types of pigment being present in the same cells.

These two types of pigment are controlled by different genes, and are independent of each other. When looking at an iris, try to imagine what it would look like with only anthocyanins or with only carotenoids. This is an essential first step to understanding the color patterns and their genetics.




## Anthocyanin Patterns and Genes

### Selfs: Blue, Violet, and White

Modern tall bearded irises all have genes that produce anthocyanin pigment in all parts of the flower. If there are no other genes controlling the production and distribution of anthocyanin, the flower will be a blue or violet self. In diploid TBs and some early tetraploids (mostly bred 100 years ago or more), the genes producing anthocyanin can exist in nonfunctioning recessive forms (alleles). If the iris has only these recessive alleles, it will be white instead of blue or violet. These irises are called "recessive whites". There may be some such recessive whites among modern tetraploid TBs, but I am not aware of any. Glaciatas (see below) are another type of recessive white that *is* found among modern TBs.

Most modern tetraploid TB white selfs are white because they carry a dominant inhibitor gene *I.* When this gene is present, the production of blue and violet anthocyanin pigments is inhibited (suppressed), and the result is a white self.

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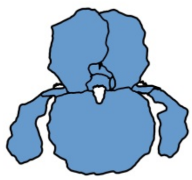
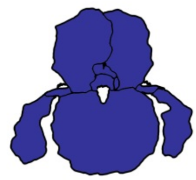
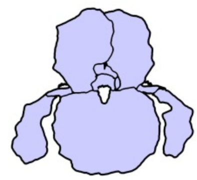
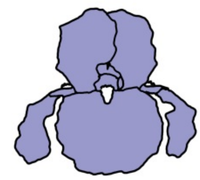
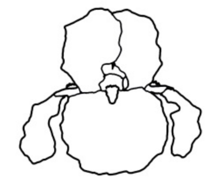
|  |  |  |  |  |
| blue and violet selfs (no *I* allele) | | | | white self (with *I*) |

Keep in mind that carotenoids pigments can be present too. A violet self with carotenoids also present will appear blended, brownish, or reddish. A white self with carotenoids also present will appear yellow, cream, pink, or orange.

### Amoenas

The term "amoena" refers to an iris with white standards and colored falls. In the context of anthocyanin pigments, it refers to an iris with anthocyanin in the falls but not in the standards.

Most modern TB amoenas are due to a dominant gene $I_s$ that inhibits anthocyanin in the standards but not in the falls. The inhibition can be complete (white standards, violet falls), incomplete (light violet standards, dark violet falls) or appear as the "Emma Cook pattern": white standards, falls white with a violet rim). These differences may be a *dosage effect,* i.e., depending on the number of $I_s$ alleles present.

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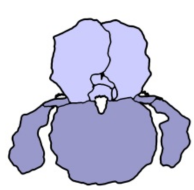
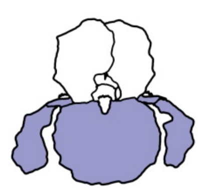
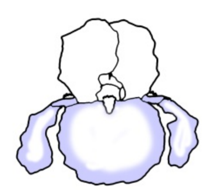
|  |  |  |
| neglecta | amoena | 'Emma Cook' pattern |

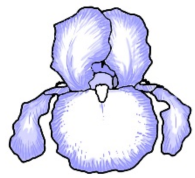
Some older TB amoenas ('Wabash' and similar varieties) have an amoena pattern with a different genetic basis. The anthocyanin in the falls is basically a large "spot" in the center of the falls, often leaving a white rim around the edges. The gene producing this pattern is recessive.

When the anthocyanin amoena pattern is combined with carotenoids, the result can be a variegata (yellow standards, brown, red, or blended falls), or a pink and purple bicolor, if the carotenoid is pink.

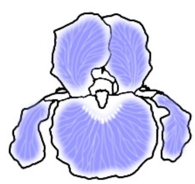
### Plicatas, Luminatas, and Glaciatas

There is a genetic locus, called the plicata locus, that affects the distribution of anthocyanin pigments in the flower. The dominant allele usually present at this locus, *Pl*, allows the anthocyanin pigment to be distributed uniformly in both standards and falls, giving a blue or violet self.

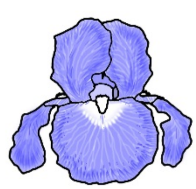
One recessive allele, *pl,* causes the anthocyanin to be distributed in lines or dots along the veins, at the edges of the petals and in the style crests, producing a plicata.



A second recessive allele, $pl^{lu}$, causes the anthocyanin to be distributed in areas that are nearly the opposite of the plicata pattern: the veins and rim of the petals are often clear, as are the style crests, hafts, and area around the beard. The main central part of the petals will show anthocyanin pigment, like a violet self, but often looking "marbled" due to less or no anthocyanin in the veins.



The alleles *pl* and $pl^{lu}$ are both recessive to *Pl,* but neither is dominant over the other. If both are present, the result is a luminata-plicata, which shows various combinations of the marbling, clear area around the beard, and lighter petal rims of a luminata with the stitching, dotting, haft marks, and colored style crests of a plicata. Luminata-plicatas may sometimes be so heavily marked as to look like violet selfs.



A fourth allele, $pl^{a}$. also exists at this locus. It is recessive to both *pl* and $pl^{lu}$. When $pl^{a}$ is present in the absence of all the other alleles, the result is a glaciata, with no anthyocyanin pigmentation anywhere in the flower. The iris is thus pure white. (The inhibitor gene *I* always leaves small traces of anthocyanin, particularly in the hafts and throat of the flower, so glaciatas are even "whiter" than the *I*-whites.)

The plicata and luminata patterns can exist in combination with the dominant amoena pattern from the $I_s$ gene, producing flowers with plicata, luminata, or luminata-plicata falls and standards that are white or lighter versions of those patterns.

When carotenoid pigments are present, the “ground color” may be cream, yellow, orange, or pink instead of white. Likewise, glaciatas can be white or any carotenoid color or pattern (yellow, pink, etc.).

### Enhanced Anthocyanin

A dominant gene $A_e$ enhances anthocyanin in the flower, sometimes resulting in flowers that are very dark and may appear black. It can be found in black selfs, in flowers with intensely dark plicata and luminata markings, and in “icy” blue and white selfs (usually with dark beards) where it partially overcomes the inhibitor *I* and produces a cool white or pale blue color.

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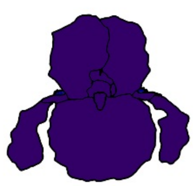
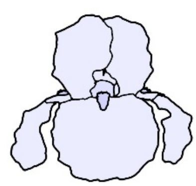
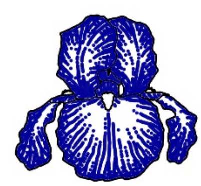
|  |  |  |
| $A_e$ violet self | $A_e$ *I*-white | $A_e$ plicata |

## Carotenoid Patterns and Genes

The genetics of carotenoid color patterns are not as well studied as those for anthocyanin patterns, so this section contains some weasel words like “apparently”.

### Selfs: Yellow, Pink, Orange and White

The genes to produce carotenoid pigment will produce a yellow self if no other genes affecting carotenoid pigment are present. These genes are apparently dominant, so that white (no carotenoid) selfs are recessive.

### Pink

In most irises, the carotenoid pigment present is beta-carotene, which is yellow. A recessive gene *t* causes the iris to produce the pink pigment lycopene rather than the yellow beta-carotene. (The gene is named *t* for “tangerine factor,” so named because of the tangerine beards common on these pink irises). Pink is not found in diploids, so perhaps *t* is the result of a mutation that occurred in the course of tetraploid TB breeding.

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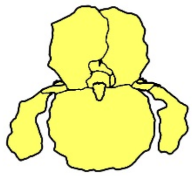
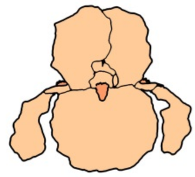
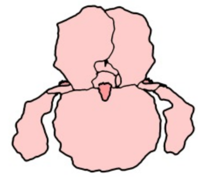
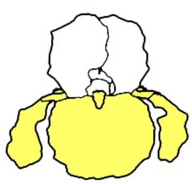
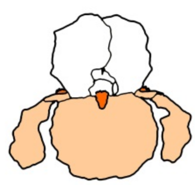
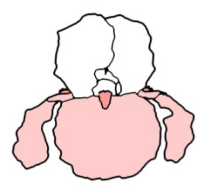
|  |  |  |
| yellow self<br>(at most three *t* alleles) | orange self (*tttt*) | pink self (*tttt*) |

Orange is a combination of pink and yellow, when an iris contains some yellow pigment that is not affected by the presence of the *t* gene.

### Amoenas

A carotenoid amoena has carotenoid pigment in the falls, but none (or little) in the standards. The gene creating this pattern is apparently recessive. The carotenoid amoena can be yellow, orange, or pink, depending on the presence of *t*. Although these irises are called “amoena”, this a different pattern than the anthocyanin amoena pattern, controlled by different genes.

### “Aurata” and Rim

A common carotenoid pattern shows pigment in the standards, and in a rim around the falls, leaving the center of the falls white (clear of carotenoid). This is sometimes called “aurata”. Sometimes the standards too are clear in the center, with pigment at the rim. The rim may be broad or pencil-thin.

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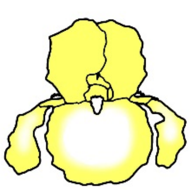
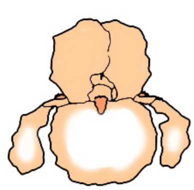
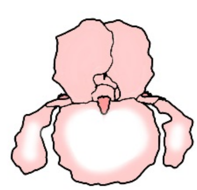
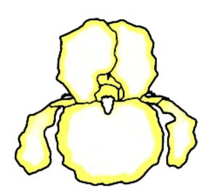
|  |  |  |  |
| yellow aurata | orange aurata | pink aurata | yellow rim |

Any of these carotenoid patterns can be combined with any of the anthocyanin patterns. For example, 'Brown Lasso', with gold standards and blue-violet falls rimmed with brown, is a yellow aurata combined with an anthocyanin amoena.

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Iris Hybridizing *Facebook group*
*2018.Mar.11*