A Few Basics on Colour Genetics of Clivias for the New Enthusiast

By Antoinette Roberts

General Information:

- Yellow flower colour is due to a mutation in the gene(s) that is normally responsible for the orange colour. The mutation causes this gene to be non-functional (sometimes called a null mutation). In the case of a dilute, this gene is defective (sometimes called a leaky null mutation), in other words, has very little function. (See Bill Morris' article in yearbook 4)
- It has been determined that two separate genes (positions on the DNA string) are involved in pigment production. Group1 and group 2 yellows are known, depending on the position in the gene at which the mutation occurred. It is highly likely that there are more than two genes that control the colour in Clivia, but it is only these 2 that are understood by breeders.

Dilutes:

- Also known as Peaches
- It is genetically an incomplete expression of the true yellow gene. (Leaky null mutation)
- It is a single gene mutation on the same locus as a group 1 yellow.
- If crossed with a group 1 yellow clivia, all the offspring will be peach.
- Peach is dominant over yellow, but recessive to orange.
- Base of seedlings is also green as with yellows.
- The name dilute is used for a mutation which can be inherited in a fixed pattern. This mutation causes the dilution of pigments.
- It is very possible that the extent of this mutation, the extent of dilution, can vary, resulting in lighter or darker peaches.
- In other words, the intensity of the pigmentation is genetically diluted.
- Group 1 peaches have the mutation in the same position on the DNA string as a group 1 yellow. Whether group 2 peaches exist has not been confirmed yet, but is possible if the same mutation to produce peaches occurred at the same location as for group 2 yellows.

Pastels:

- It is a pale orange and genetically unrelated to yellow.
- Pastel crossed with yellow will most likely only yield orange offspring.
- Pastel is rather a colour variant that were obtained through selection.
- Line breeding of flowers with similar lighter or different colours will result in pastels.
- Base of the seedlings will be red/orange. This could assist one to distinguish between true peach and pastel plantlets.
- Berry will also show same colour as for orange flowers.

Yellows:

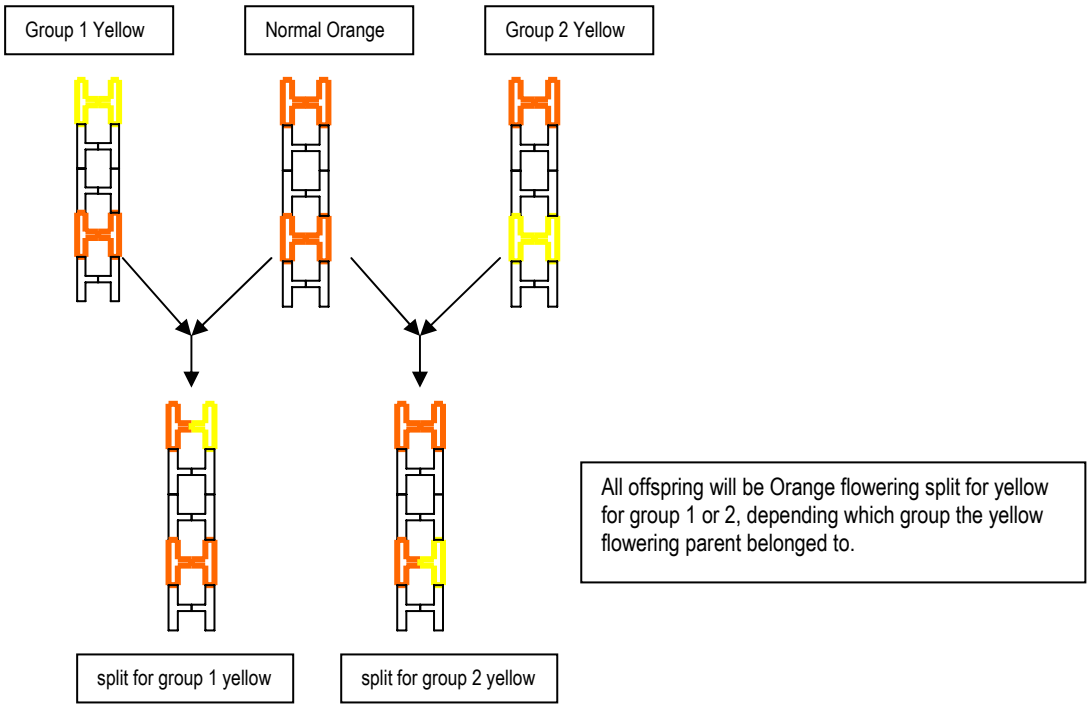
- The berries of group 1 yellows are uniformly yellowish green to yellow.
- The berries of group 2 yellows are normally a golden yellow with a red tint, or red specks. (Berries must be completely ripe to observe this). This means that a very small amount of anthocyanin is in fact produced but shows up as spots or streaks. These spots and streaks can also appear in the flower petals.

- Most yellows in New Zealand are thought to be group 1 yellow and genetically compatible.
- Very few group 2 yellows are known/available.
- If a group 2 yellow is selfed or crossed with another group 2 yellow, all the offspring will be yellow.
- If a group 1 yellow is selfed all the offspring will be yellow. (Or crossed with another group 1 yellow)

This is only a simplified summary of information obtained from several articles and e-mails from various sources and is aimed at the novice grower. I do not consider myself an expert in the field of genetics, but am aware of the confusion it can create. Hopefully, this article will answer some questions and provide a better understanding about the colour genetics of Clivias. For myself, I am hoping that by keeping things simple and following the above guidelines, I will be able to establish the breeding behaviour of my plants, without getting wrapped up in too much science. All the conversation and information about the genetic behaviour of Clivias is overwhelming and to keep myself sane and from losing perspective I try to keep things simple. It is not the end if I do not know the exact make up or grouping of my plants, but with some patience, a basic

understanding and some common sense I can determine the breeding behaviour of my plants without getting wrapped up in too much science!

What does split for yellow mean?



The genetic code in a plant is made up of DNA strings that are similar to a zipper. When a plant flowers this genetic zipper is 'unzipped' and one half is kept in the pollen on the anthers and the other half kept in the egg cells in the ovary at the base of the stamen.
These teeth are in pairs called alleles, when the zipper is closed, each 'tooth' in the zipper strand is responsible for the inheritance of specific traits and characteristics. In the case of colour inheritance of the clivia flower there are 2 pairs of 'teeth' or positions on the DNA strand responsible for it(that we know of). If the teeth in a pair are the same, ie orange the plant will be homogenous for that trait, if they are different, say one is orange and one is yellow, the plant will be heterogenous for that trait. In these pairs usually one 'teeth' is dominant and the other recessive. In clivia we know that orange is dominant over peach and yellow, and peach is dominant over yellow. If we know a plant is heterogenous for colour we say it is split for yellow or peach, depending on what the recessive colour is.

Homogenous and heterogenous plants have the same phenotype, but different genotypes. Phenotype is how the plants look, ie they are both orange flowering, but their genotypes are different as one is genetically split for yellow.

During pollination combining the halves from the pollen and egg cell forms a new zipper. How the new zipper will look will depend on the parent plants. It is therefore important to know whether your plants are homo- or heterogenous if you want to be able to predict the outcomes of your breeding program.

How can I find out if my plants are homo- or heterogenous (split for yellow/ peach)?
Yellow Flowering plants:

- As far as we know, all yellows are homogenous, as yellow is a recessive colour to peach and orange.

Orange flowering plants:

Pollen (male) parent	Seed (female) plant	
	O	**O**
O	OO offspring	OO offspring
O	OO offspring	OO offspring

Self pollinate the plant, and a year later when all seeds(100%) are germinated and showing pigmentation at the base of the seedlings, you know the plant in question is homogenous for orange flowers.

Pollen (male) parent	Seed (female) parent	
	O	**Y**
O	OO offspring	Oy offspring
y	Oy offspring	yy offspring

(If you self the plant and 25% of seedlings is yellow then the plant is split for yellow. The problem is that of the remaining 75% orange seedlings some will be homogenous and some will be split for yellow and you will not be able tell them apart at that stage.)

Pollen (male) parent	Seed (female) parent	
	y	**Y**
O	Oy offspring	Oy offspring
y	yy offspring	yy offspring

Cross pollination with a yellow will give 50% unpigmented seedlings if the parent plant is split for yellow.

Pollen (male) parent	Seed (female) parent	
	y	**Y**
O	Oy offspring	Oy offspring
O	Oy offspring	Oy offspring

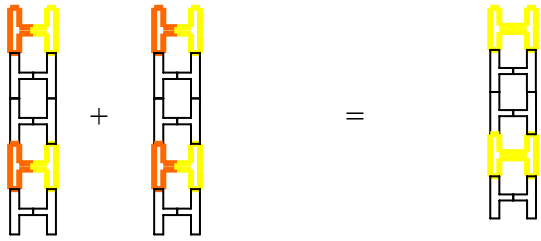
If the parent plant is homogenous all seedlings will be orange and split for yellow.

Group 1 and 2 yellows:
"I have a yellow plant, but am not sure which group of yellow it belongs to"

If you have a yellow that you know is group 1, such as Vico yellow or any of its progeny, cross pollinate it to the unknown yellow. If you do not have a known yellow try and obtain some pollen from a friend or fellow club member with known hybrids to pollinate on to your plant. If the seedlings all have unpigmented bases, you will know which group your yellow belongs to. If they are all pigmented, it is highly likely that the 2 yellows belong to different groups. It is also possible that the bees or the wind may have contaminated your pollination efforts. It is therefore important to isolate the plant or plants you are working with and take precautions to avoid other pollen contaminating your trials.

Pollen (male) parent	Seed (female) parent	
	y2	**y2**
y1	y1y2 offspring	y1y2 offspring
y1	y1y2 offspring	y1y2 offspring

In this case all the seedlings will flower orange, but they will be split for yellow at both positions on the DNA string. Although many people warn against this cross as it complicates matters, I cannot help but wonder what the progeny would look like if two of these seedlings were crossed or one even selfed.



It will result in a plant that is homogenous for yellow at both positions in the DNA string, but what will it look like?

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