



The Avicultural Society of New South Wales (ASNSW)

(Founding in 1940 as the Parrot & African Lovebird Society of Australia)

Genetics for Bird Breeders (Part I)

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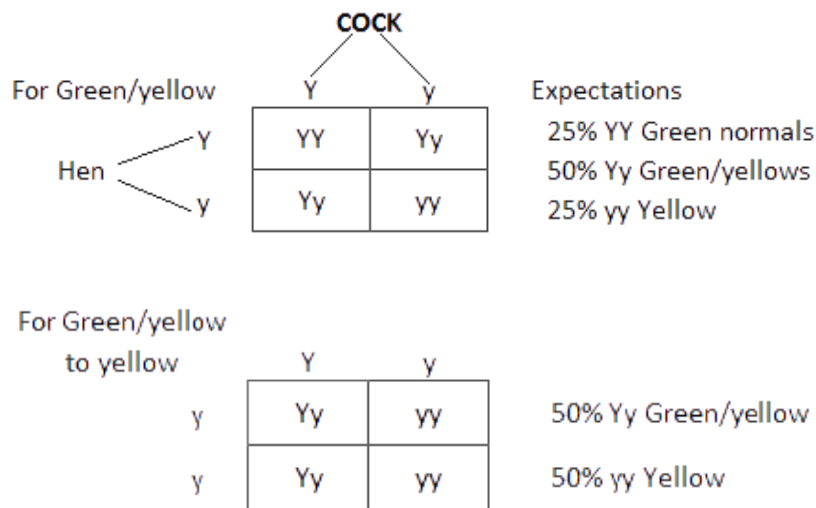
By Peter R. Head

The very basics of genetics for bird breeders should begin with feather structure and pigmentation and then gradually extend to the study of [genes](#), how [mutation](#) effects them, their position on the [chromosome](#), and which chromosome holds them. Somewhere in the graduation of this study the terms "dominant", "semi-dominant", "recessive" and "sex-linked" emerge and I am constantly amazed at the non-understanding of these terms. I certainly don't claim to know all the answers but anyway I'll try to write something of what I know.

Dominant usually means just what it says and generally refers to the wild or normal form of birds. Perhaps it should be called "totally dominant" or "fully dominant" when used in this way because as I hope to explain later, the used of "dominant" is sometimes ambiguous. For example green is dominant to yellow, yellow is dominant to blue and blue is dominant to white. Only green is fully dominant, though. In [Budgerigars](#) only green and grey are fully dominant colours.

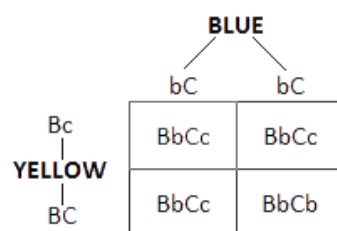
Semi-dominant may be important. Pies in budgies are either "recessive" or "semi-dominant". Pied is not actually a colour so that pied genes are only modifiers to the normal ones. Semi-dominant piers can produce pied offspring from one pied parent and one normal, and about 50% should be pied. As far as I know, semi-dominant only ever shows itself as a modifier to a colour, such as pied, yellow face, violet, etc., rather than an actual colour like blue or green. If two semi-dominants such as piers are mated it will produce 25% double factor piers, 50% single factor piers, and 25% normals, i.e. non pied. No bird can be split for any dominant or semi-dominant effect. Single and double factor refers to the pair of genes controlling the pied modifier. Because the mutation is semi-dominant, one gene of the pair (they are always in pairs) is enough to produce the mutation i.e. single factor. Double factor birds are not twice as pied, but in fact are indistinguishable visibly. Both genes of the pair are carrying the pied mutation and when a double factor bird is mated to a normal, all the young will be pied, all single factor pied. In a way double factor semi-dominants act like fully dominants, but only for one generation.

Recessive is the commonest term, of course, and very important. The gene controlling the colour of the bird, always in pairs or numbers of pairs, are, as I've already said, usually dominant in their normal form, and when written in Genetic formulae are denoted by the capital letters, of which the same lower case letters denote the recessive mutation. Don't be frightened off by genetic formulae. They are really quite simple, and make it possible to find the results of complex matings where different mutations are concerned, as I hope to show later. There is a standard code of letters used but for our purposes it's not of major concern. Because we are talking about recessive mutations in this case and because they are the ones we want to keep simple, we always work back from the letter (lower case) referring to that recessive. For example we may wish to use "y" to signify a yellow [Peach-face](#) (I think it's wrong as I'll explain later, but it will do for now). Both genes must be yellow to have a visible yellow bird so that the formulae is written y/y or yy. The un-mutated dominant or wild form for these genes would be written Y/Y or YY. Now of course the only other one we need is Y/y or Yy. The Y signifies that one gene of the pair is un-mutated and dominant. The y tells us that the other gene is yellow and recessive. If either of the genes is dominant over the other it is written on top or first, i.e. Yy therefore Yy is green split yellow. Blue is correctly written bb. Following the same pattern Green/blue is Bb and green is BB. This may seem confusing as YY and BB are both green and could in fact be the same bird. Perhaps you may find it easier to think of YY as dominant non yellow, and BB as dominant non blue. Well, now, why bother with all this? Remembering all the while that colour is the only genetic trait we are talking about, (there are many others) each gene having a controlling interest in the colour of the offspring must be considered with any other combination available to it. The easiest way to do this is to match them across a square section as follows:-



I said before that the yellow Peach-face genetic formulae yy was not quite accurate. As I've said on other occasions the yellow Peach-face is a bit of a puzzle as there appears to be two types, and as yet I'm not at all certain of their particular genetic characteristics or differences. So for now I'll use the recessive black eyed yellow Budgerigar as a model. This bird is genetically a dilute green, and its cousin the white is the dilute form of blue. "Dilute", like pied, is not actually a colour, it's a modifier, this time recessive. The modifier genes may be represented by "C" for non modified or full colour and "c" for the dilute or modified colour. Therefore yellow would be $BBcc$. BB denoting a green series bird and cc the dilute form of the green series. $BBCC$ then is the normal green bird. You can see that the formulae for the normal green bird changes depending on which mutation relative to it, is under study. Following on them $BBCc$ would be green/yellow, and going further still $Bbcc$ would be yellow/blue. So you can see in revision that the normal colour gene C has been modified by the recessive dilute gene c which in a double dose becomes visible and when acting on a green series bird gives yellow. To further complicate things, when a yellow and blue were mated all the young would be green, not because yellow and blue make green, but because yellow is actually only a double factor dilute green, which, although it may be recessive to normal green is still dominant to blue.

The parent bird can only pass on one gene at a time from each pair it possesses. So we can see in a mating between two green/split blue birds i.e. Bc to Bb . Each bird can pass on either "B" (green) or "C" (blue) and depending on which gene from one pair combines with which gene from the other partner we may get either BB , Bb or CC . Now if we are going to speak of colours and modifiers at once, say when breeding a yellow with a blue, blue is $bbcc$, the double factor blue genes bb giving the blue colour, and the dominant non-dilute factor being shown by the capitals CC . One gene from each pair, whichever way they are passed on, end up in being available as "bc". Now the yellow bird $BBcc$ can likewise pass on as "Bc" (or "bc").



If "bC" and "bc" are applied as in the figure above, all the offspring end up as $BbCc$. Bb - green/blue and Cc is full colour/dilute, so we have green birds split for yellow and for blue. Blue is a mutation and dilute is a mutation. We need green plus the dilute mutation to get yellow. White is not a direct mutation, rather a combination of two other mutations, blue and dilute. You've probably already guessed that I'm leading up to breeding a white Peach-face. So now we must mate a green/yellow-blue to another green/yellow-blue, i.e. $BbCc$ to $BbCc$. Now as each parent passes on one gene from each pair this time we have four possible combinations namely BC , Bc , bC and bc . After a while you will be able to do the simpler matings without the assistance of the square, however, for this particular mating the square (for me anyway) is essential.

	BC	bC	BC	bc
BC	BBCC Green	BbCC Green/Blue	BBcC Green/Yellow	BbCc Green/Yellow-Blue
bC	BbCC Green/Blue	bbCC Blue	BbCc Green/Yellow-Blue	bbCc Blue/White
Bc	BBcC Green/Yellow	BbCc Green/Yellow-Blue	BBcc Yellow	Bbcc Yellow/Blue
bc	BbCc Green/Yellow-Blue	bbCc Blue/White	Bbcc Yellow/Blue	bbcc White

In colours we get nine greens, three yellows, three blues and one white. With this mating the chances of breeding a white are one in 16. This could be improved of course by mating the blue/whites, if you can pick them. It must be remembered that any colour can only be split for something recessive to it. Blue can be split for white but not for yellow. Green is dominant to yellow which is dominant to blue which is dominant to white. Similarly, white is recessive to blue which is recessive to yellow which is recessive to green. Nothing can be split for green, and white can't be split for anything.

Well that will do for now on "recessive". I hope you can understand my presentation of it.

Continued in [Part II](#) (*Avidata: Official Journal of the ASNSW September-October 1976 New Series No. 5*)

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