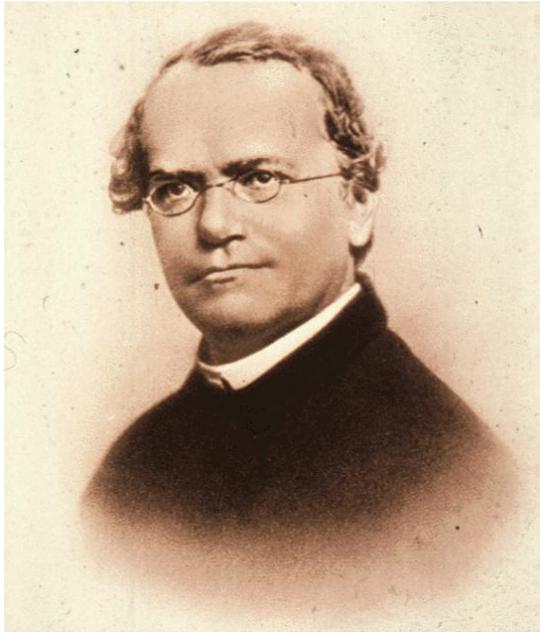


Mendel's Peas

Gregor Johann Mendel



(born 22nd July 1822, died 6th January 1884)

Born to well off peasants, he entered into the 'Koniginklosser', an Augustinian foundation in Altbrunn in 1843 and was ordained a priest in 1847. He travelled to Vienna where he studied physics and natural science from 1851–1853. On returning to the cloister he taught in the Realschule in Brunn where he later became Abbot. It was in 1856 and the following years that he undertook his investigations into hybridisation of plants in the garden of the convent.

Through the careful study of experimental crosses between pure breeding pea lines varying for different characters he was able to establish the mathematical basis of the inheritance of characters.

He published his work in the seminal paper of 1865 (1) but, due to the relative obscurity of the journal, the work remained unnoticed for over three decades. Plant hybridisation was an extremely active area of scientific and horticultural endeavour across Europe and North America at this time well illustrated by the International Conference of Hybridisation staged by the RHS in July 1899 (2). In the following year De Vries and others, who were close to answers themselves, came across Mendel's work and word reached William Bateson who reported on the paper during a presentation to the Royal Horticultural Society in May of that year. Bateson was commissioned to translate Mendel's paper which appears the following year (3).

Why Peas

Mendel was clearly well aware that there were certain preconditions that had to be carefully established before commencing investigations into the inheritance of characters. Firstly the parental plants must known to **possess constant and differentiating characters**. He undertook a preliminary trial a year in advance of the crosses to establish that the lines were indeed true breeding and the characters constant. Secondly, the **flowers of the hybrid plants should be protected from any foreign pollen**. The special shape of the flower of species of the *Leguminosae* with their enclosed styles drew his attention and on trying several, finally selected pea as his species of choice.

Plant material Mendel used

There is no evidence as to the exact lines Mendel used for his studies. His paper records they were lines obtained from several seed merchants of the day. Peas at that time were a highly prized vegetable and a wide range of forms were on offer. The availability of such varied material is demonstrated by an illustration from the *Album Benary* (1876–93) which clearly depicts three of the characters with which Mendel worked (see plate from the album).

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Mendel made notes on a range of plant characters. He discussed the selection of the specific pairs of characters for his studies as being arrived at as those that showed clear and sharp separation when segregating. This removed the uncertainty of characters which were less distinct or '*more or less*' in character. While lacking the exact lines that Mendel used, much material contemporary with that of the day has found its way into germplasm collections from commercial sources and from geneticists who followed up on Mendel's work.

Once recognised, the mathematical basis that Mendel established for the inheritance of independent characters saw many work to apply and develop these theories to a wider range of inheritance problems. As more characters were worked with, the algebraic lettering was revised and a system of gene symbols came into effect based on a three letter system. The convention of using a capital for the dominant allele and a lower case for the recessive 'hidden in the hybrid' was outlined by Mendel and is still used today.

The drawing together of genetic stocks as reference or type lines and the assembly of all the associated information has been an important activity as the number of stocks and publications on pea genetics. The drive to collate stocks and information was initiated by the late Stig Blixt during his time at the former Weibullsholm Plant Breeding Institute in the 1960's and in later years at the Nordic Gene Bank at Alnarp in Sweden until his retirement in 1996. The responsibility for the Pisum Genetic Stocks Collection and the management of the Pisum Gene List was accepted by the John Innes Centre in 1992 (4).

References

(1) Gregor Mendel 1865. Versuche über Pflanzen-Hybriden. Verh. Naturforsch. Ver. Brunn, Vol 4:3–47.

(2) Hybrid Conference Report 1990. International conference July 1899. On hybridisation (the cross-breeding of species) and on the cross-breeding of varieties. Journal Royal Horticultural Society. Vol 24:

(3) William Bateson 1901. Experiments in plant hybridation by Gregor Mendel. Journal Royal Horticultural Society. Vol 26(1): 1–32.

(4) Michael Ambrose 1992. Pisum Genetic Stocks Collection. Pisum Genetics Vol. 24:92.

Characters Mendel studied

Mendel's published work refers to a range of characters; Length and colour of stem; size and form of leaves; in the position, colour and size of flowers; in the length of the peduncle; colour, form and size of pods; form and size of seeds; colour of seed coats and cotyledons. As stated earlier many of the characters were not sufficiently clear in the scoring of segregation ratios to be used. The analysis was therefore restricted to the seven characters illustrated below.



'Difference in the form of the ripe seeds'

Round (*R*) and wrinkled (*r*) cotyledons

A cotyledon character resulting in a wrinkling in the mutant form when seed is mature. The thin walled testa collapses around the seed during maturation.

Lines: *RR*J1 502 , *rr*J1 2684



'Difference in the colour of the seed albumen'* *denotes cotyledon

Yellow (*l*) and green (*i*) cotyledons

This character is again assessed when the seeds are mature. Immature cotyledons are green and it is the lack of chlorophyll breakdown which characterised the green of the mutant phenotype.

Lines: //Jl 4 , iiJl 2775

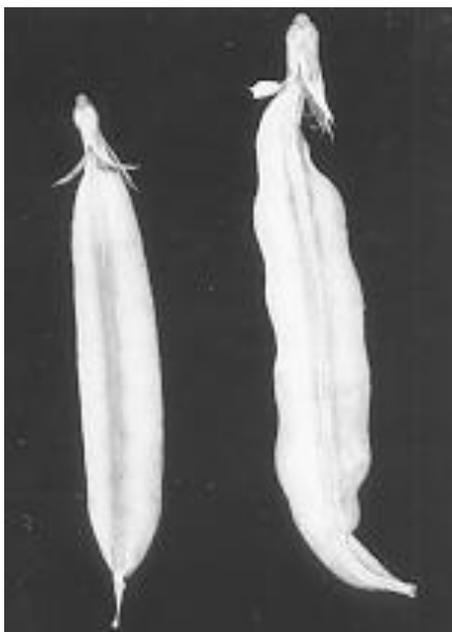


'Difference in the colour of the seed coat'

Coloured (*A*) and white (*a*) flowers

Originally worked on as a testa character. The presence of pigments in the seed was found to be linked to flower colour. Locus is now associated with presence or absence of pigment in the flower

Lines: AAJl 2423 , aaJl 4



'Difference in the form of the ripe pods'

Parchmented (*V*) and parchmentless (*v*) pod wall

Parchment is the layer of secondary thickening (sclerenchyma) that develops as the internal layer of the pod wall. Results in smoothed walled (*V*) or a beaded (*v*) appearance where the pod following the contours of the seeds.

Lines: VVJl 68 , vvJl 67



'Difference in the colour of the unripe pods'

Green (*Gp*) or yellow (*gp*) pod wall

Lines: *Gp*Jl 4 , *gp*Jl 128



'Difference in the position of the flowers'

Non-fasciated (*Fa*) and fasciated (*fa*)

The character is based on apical fasciation which greatly reduces internode length in the later stages of plant growth. This results in all flowers being condensed at the top of the plant in the form of a false umbel type.

Lines: *Fa*Jl 2694 , *fa*Jl 5



'Difference in the length of the stem'

Long internode (*Le*) and short internode (*le*). Tall and dwarf

Lines: *Le*Jl 15 , *le*Jl 2682

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