

A collaboration between the research group of Ronald Koes and Francesca Quattrocchio and artist Christian Herren

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The collection of petunia mutants of the UvA.

The historic petunia lines collection

Petunia as group of species is known since 1803 when Jessieu described it as part of the family of the *Solanaceae* (Nightshades) which includes known vegetables like tomato, potato, pepper and eggplant. Petunias live in nature at the feet and along the slopes of the Andes.

The first reports of petunia cultivation in Europe is from 1823 in the botanical Garden in Glasgow and concerned the germination of seeds from a petunia wild species sent as a curiosity from Argentina. Since then, petunia became a favorite species among garden plants and lots of varieties appeared from the crosses among the different wild species collected in South America.

Only in the 1950's petunia started to be the object of breeding driven by genetic analysis of different lines, and this happened in the University of Amsterdam, in the research group of Prof. Frans. Bianchi at the Genetics Institute. At that point petunia became a research model for different biological processes going from flower pigmentation genetics and pigment synthesis, male sterility in plants and in vitro tissue culture. The institute collected petunia lines from breeders as well as from botanical gardeners and started to isolate pure lines differing by flower color and shape.

In the 1980's a research group in France at Dijon adopted petunia to study chromosomes. When shortly after the Genetics Institute of the UvA was shut down, the genetic material almost got lost and was rescued by the set up of new group at the Free University Amsterdam (VU) focusing on plant molecular biology. In this group, the description of transposon biology in petunia provided the basis for large mutagenesis programs that resulted in a great amplification of the lines and provided different mutants that allowed study previously difficult to approach biological processes.

Due to the large mutant collection, this species got used in several research institutes in Europe and in the whole world and the Petunia Platform was founded in the 1990's to grow to a Scientific Community with some 50 member labs (<https://flower.ens-lyon.fr/PetuniaPlatform/Home.html>).

In 2014 the history seemed to repeat and the petunia group at the VU got endangered by a reorganization taking place within the Faculty of Health and Life Sciences. It was in that occasion that the UvA took the group and the petunia collection back making Science Park once more the home of this instrument of the international scientific community.

The present and the future of petunia research

Very different aspects of plant science and general biology are nowadays studied using petunia as model. This is also thanks to the continuously increasing mutant

lines available (which are now also getting produced by direct gene editing) and of techniques this species is amenable to.

The petunia lines collection is the basis for research work in the department of Plant development and (Epi)Genetics of the UvA, provides mutant lines to labs all over the world, makes genetic material available for schools that use it to set up experiments during lab classes, is the basis of several practical courses in the UvA, is the source of information and inspiration for companies in both the ornamental and the agrofood sector.

Among the most notable findings that came from the use of petunia are:

- Regulation of pigmentation pattern formation
- Several aspects of transposon biology
- Gene silencing by RNA interference
- Regulation of cellular pH
- Formation of intracellular membrane compartments
- Plants-fungus interaction
- Genetics of plant and flower architecture
- Control of pigment stabilization in plants and fruits
- Different aspects of speciation
- And much, much more...

From these findings, several applications were generated, and several more are foreseen for the near future:

- Novel colors for new varieties of flowers
- Breeding programs for improved fruit taste and stable amount of antioxidants in food
- Identification of genes useful in breeding programs for different crops
- Plant production of high valuable molecules for human use: vitamins, antibodies, vaccines, colorants ...
- Plant based proteins production to replace meat