https://buergeruni.hhu-blog.de/index.php/2022/11/21/eine-kleine-pflanze-wird-zum-star-fuer-buergerwissenschaft/

A small plant becomes a star for citizen science

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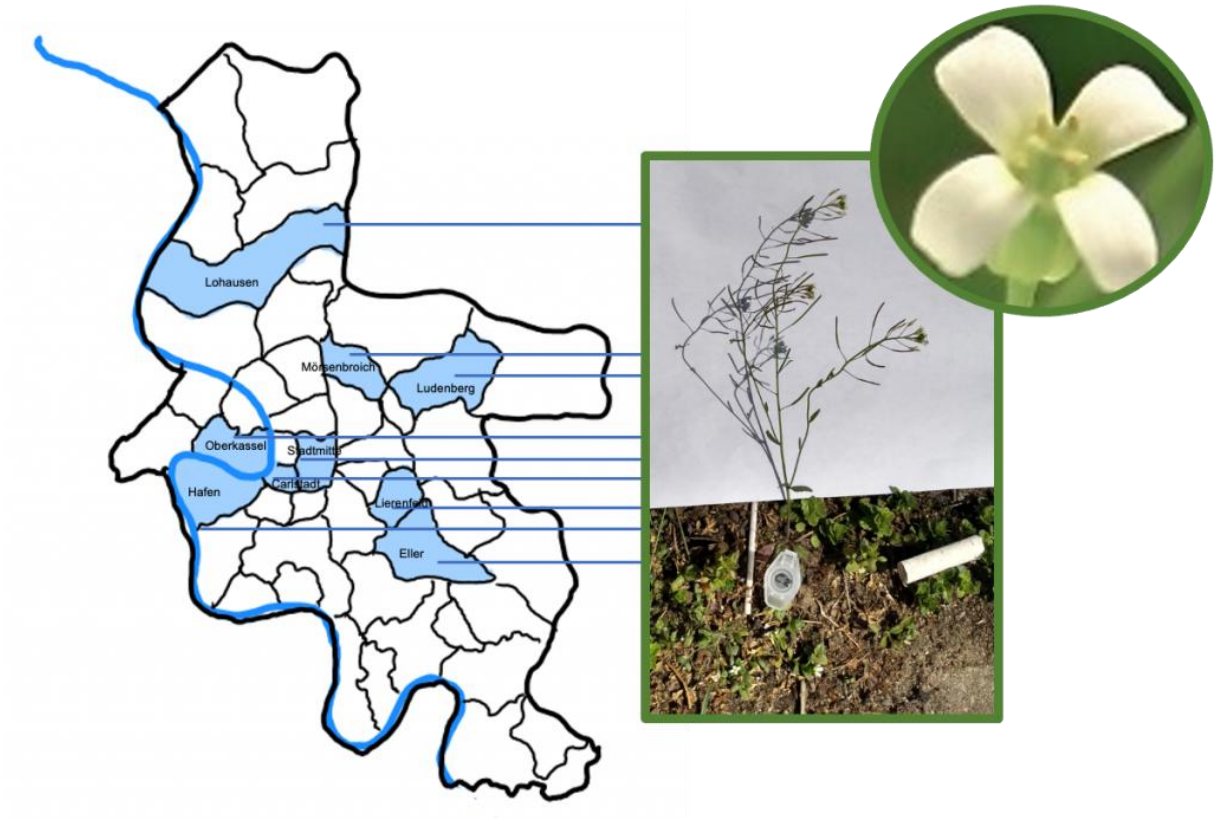
New project aims to involve the public in plant genetics research project

Most people probably trample on them and don't even realize that they are trampling on a star of plant science.

This megastar in plant science is a small, inconspicuous inhabitant of the city of Düsseldorf. Its scientific name is *Arabidopsis thaliana* and its English name is thale cress[1] and it lives with its peers on roadsides, fallow land and green spaces, preferably in urban areas. It is also often found in the gaps between paving stones. The compressed axis with alternate leaves at the base of the stem is a small, flat rosette. With only one such rosette on the surface, this plant goes dormant in winter and only comes back when the temperatures rise in March and the days get longer. Then it shoots up, flowers and bears fruit. Its numerous seeds fall from the open pods in April and can then even be spread by dog paws and the soles of shoes. Shortly afterwards, the thale cress disappears again without a trace, the seeds remaining dormant through the summer until the next generation reappears as a rosette in the fall.



In some years, we see thale cress frequently, as we did this year. In April 2022, student teacher Sarah Weirauch went in search of flowering thale cress in Düsseldorf. Sarah roamed the city on her bike in fine weather and discovered thale cress individuals at eight locations in just three days (see map above). She noted differences in the size and colour of the rosettes, and reproduction did not appear to occur with the same intensity at all locations.

Photos by S. Weirauch, P. Bauer
Thale cress (*Arabidopsis thaliana*) tracked down as part of the bachelor thesis by

student teacher Sarah Weirauch in 2022 in the Düsseldorf urban area; in April 2022, flowering and fruiting plant highlighted by a sheet of paper (right). Rosette of the next generation in hibernation in October 2022 (left).

What Sarah wanted to find out with her detective work were the answers to some questions she had asked herself with her bachelor's thesis:

• Is it easy to find thale cress plants in urban areas and examine their genetic information with regard to the described morphological and genetic characteristics[2] in order to later develop an interesting ecological school project based on this research?

• Are all thale cress individuals in the urban area closely related to each other? Or are there differences?

Studies of the *FRIGIDA* gene provided an initial indication. As the name suggests, *FRIGIDA*, or *FRI* for short, influences how early plants flower after exposure to cold[2]. Sarah collected plant samples from the eight thale cress sites and extracted the genetic material, chemically speaking DNA (deoxyribonucleic acid, a long chain molecule composed of four different building blocks in different sequences, which encodes the genetic information). Using the PCR method (polymerase chain reaction), Sarah amplified small pieces of the *FRI* genes from her collected plants and decoded the genetic information they contained by DNA sequencing, i.e. by determining the sequence of the four DNA building blocks.

What amazed us was to find that this *FRI* genetic information was actually similar to that of thale cress plants originating from distant parts of Europe and America and described in the literature in the same way[2]. Thus, thale cress, this small inconspicuous species, seemed as mixed and diverse as the human inhabitants of Düsseldorf. The differences in the *FRI* gene indicated that some thale cress individuals probably flower earlier than others for genetic reasons. Perhaps the short winter in 2021–2022 contributed to the fact that certain genetic variants of thale cress felt really comfortable this year and therefore reproduced particularly well.

Who knows what other genetic treasures the thale cress has to offer? Perhaps an adaptation to the pavement joints created by humans, which heat up quickly and are dry and nutrient-poor when filled with sand? After all, it is impressive how some plant specialists survive in urban pavement joints![3]

These pavement plants were also the focus of two events at which we introduced citizens to the amazing adaptations of these plants. Visitors to our Science Lunch event in the Botanic Garden in July (on the hottest day of the year, of all days, climate change sends its regards) and the HHU Science Night in September were enchanted by the pavement plants. The visitors marvelled at the differential growth of our thale cress laboratory plants in various commercially available grafting materials (i.e. the plasticity

with which the plants develop completely differently in different environments) and took home easily self-isolated DNA in a reaction vessel. And we were very impressed by the descriptions and efforts of many fellow citizens to maintain a colourful life of plants and sand bees in the pavement joints in front of their homes.

Photos by K. Panigrahi, A. Kumari
Staff and students from the Institute of Botany talking to members of the public about ecological and genetic adaptations of plants at a Science Lunch event in the Botanic Garden in July (top) and the Night of Science on Schadowplatz and in the Haus der Universität (bottom) in September 2022.

From 2023, the thale cress is now to be given an even bigger star role. The Collaborative Research Center TRR 341 “Plant Ecological Genetics”, a joint project involving several universities, wants to recruit citizen scientists to go on a journey of discovery just like Sarah and track down the locations of the thale cress and several similar species. This new citizen science project aims to involve associations and organizations interested in nature, educational institutions, students, schools and the interested public to work with scientists to collect and analyse data on ecological and genetic adaptations in order to better understand the genetic adaptations of plants to rapidly advancing environmental changes[4,5]. At the same time, knowledge transfer and public relations work are intended to raise awareness of

- the significance of plants in ecosystems,
- the various challenges and threats to which plants are exposed,
- the role that genetics plays in the adaptation of plants to environmental changes.

The Citizen Science project has five implementation goals (engagement, preparation, collection of research data, data analysis and data dissemination). Citizen scientists can contribute to supra-regional plant monitoring by collecting data, for example with the mobile app Flora Incognita[5,6], but they can also contribute to the development of collection methods, knowledge transfer and public relations. For example, citizen scientists can help discuss controversial topics such as genetic modification of plants and rethink them from a different perspective. We very much hope that the CS project will create a vibrant community of connected citizen scientists and researchers. Interested citizens and schools are welcome to contact us: https://www.puki.hhu.de/.

Further information can be found here:

[1]https://www.deutschlandfunk.de/arabidopsis-als-modellpflanze-100.html, a particularly good illustration can be seen at https://elifesciences.org/articles/06100.

[2]Johanson et al. 2000. Molecular analysis of FRIGIDA, a major determinant of natural variation in *Arabidopsis* flowering time. Science 290:344-347. https://doi.org/10.1126/science.290.5490.344

[3]http://www.flora-deutschlands.de/Publikationen/OEKO_2013_02_Pfasterritzengesellschaft.pdf

[4]https://zenodo.org/record/6587158#.Y2OSNC9Xa_w

[5]https://www.puki.hhu.de/

[6]https://floraincognita.com/, see also Mäder et al. 2021. The Flora Incognita app-interactive plant species identification. Methods in Ecology and Evolution 12:1335-1342. https://doi.org/10.1111/2041-210X.13611

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