



Boosting technology transfer and responsible research and innovation (RRI) in plant sciences

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What is it about?

PlantHUB is a European Industrial Doctoral Programme (EID) funded by the H2020 PROGRAMME Marie Curie Actions – People, Initial Training Networks (H2020-MS-CA-ITN-2016). The programme is managed by the Zurich-Basel Plant Science Center. PlantHUB offers training to 10 PhD students in skills and competencies necessary to apply responsible research and innovation (RRI) in the area of plant breeding and production. The programme addresses the demand for RRI leadership in plant science related research and diffusion of innovation.

Academic – Industry Collaboration

Academic interface

- ETH Zurich (Switzerland)
- University of Zurich (Switzerland)
- University of Basel (Switzerland)

Industry interface

- CARLSBERG GROUP, Carlsberg Research Laboratory (Denmark)
- Deutsche Saatveredelung AG (Germany)
- BASECLEAR BV (The Netherlands)
- Photon Systems Instruments (Czech Republic)
- HELIOSPECTRA (Sweden)
- AGROISOLAB GMBH (Germany)

PlantHUB- Company site visit

Deliverable 36

Dissemination level: public

Date: 26.02.2020



PlantHUB Consortium at the Carlsberg Research Laboratory, Copenhagen Image: A.Hochmuth

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PlantHUB Deliverable 36, 2020

Publisher
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www.plantsciences.ch/en/research/fellowships/PlantHUB.html



This project receives funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 722338 - PlantHUB.

D36: Company site visit

In PlantHUB we do implement collaborative research and knowledge transfer between the academic and industry sector as key sources of innovation, consistent with the principles of Responsible Partnering.

Programme-wide networking and integration activities such as the three integration workshops (M12, M24, M36), coupled to the yearly Annual Meetings and the company site visit to Carlsberg Research Laboratory, have been organised with the aim to give the PlantHUB consortium members an opportunity to get to know each other and built future collaborations in the area of plant breeding and production.

Originally three company site visits have been envisaged to Carlsberg Research Laboratory (Denmark), Deutsche Saatveredelung AG and LemnaTec AG (both Germany).

As LemnaTec AG has terminated its activities within PlantHUB in M23, this company site visit could not be realised.

Even though Deutsche Saatveredelung AG has invited all PlantHUB partners to join them at their open field days in June and September 2019 (M31 and M34), it was not manageable for the consortium to go there.

In November 2019 (M36), the entire PlantHUB consortium visited the Carlsberg Research Laboratory in Copenhagen.

The aims of the company site visit were:

- Exchange state of the art knowledge
- Expand the network
- Initiate further collaboration
- Increase the innovation capacity of partner organisations
- facilitate the flow of knowledge into new R&I projects

The company site visit to CLAB was part of the third PlantHUB Annual Meeting

Arrival Day	Day 1	Day 2
Welcome Dinner for all academic and industry PIs	PhD Retreat: Oral scientific presentations of all ESRs, with focus on the exploitation of the individual research projects Site visit at Carlsberg Research Laboratory Integration Workshop: Efficient strategies for genome sequencing and assembly	Supervisory Board and General Assembly Meeting

Company site visit to Carlsberg Research Laboratory, Copenhagen

19.-21.11.2019 (M36)

**Location: Carlsberg A/S Group Research/Carlsberg Research Laboratory
J.C. Jacobsens Gade 4, DK-1799 Copenhagen V, Denmark**

The third PlantHUB Annual Meeting in November 2019 (M36) was hosted by the Carlsberg A/S Group and took place at the premises of the Carlsberg Research Laboratory (CLAB) in Copenhagen, Denmark, one of the industrial partners within the consortium.

The two-day company site visit was composed of:

- A PhD retreat, there the individual fellows reported on the exploitable results of their individual research projects. Whereas exploitation is the use of results for commercial purposes or in public policymaking.
- The integration workshop on efficient strategies for genome sequencing and assembly moderated by Prof. Bruno Studer (ETH Zurich) with contributions from the University of Zurich and BASECLEAR BV (The Netherlands). For example, Prof. Elena Conti (University of Zurich) gave an interesting insight in high-quality genome assembly efforts (i.e., reference genomes), especially in light of on-going international efforts such as the Earth Biogenome Project.
- A site visit to the premises of the Carlsberg Research Laboratory (CLAB) with a guided tour through the research facilities (historic and modern labs as well as greenhouses).
- An excursion to the rich historic heritage of the Carlsberg Research Laboratory (CLAB) and an introduction in the sustainable brewing technological processes.

The Carlsberg Laboratory in Copenhagen, was created in 1875 by J. C. Jacobsen, the founder of the Carlsberg brewery, for the sake of advancing knowledge relating to brewing. Today, Carlsberg Research Laboratory's interdisciplinary teams with expertise in brewing science, chemistry, biochemistry, physiology, genetics, bioinformatics and molecular biology work together to further perfect the art of brewing. Carlsberg Research Laboratory is an integral part of the Carlsberg Group and Carlsberg Foundation family.

Senior Scientist Dr. Søren Knudsen, who has spent + 30 years at the laboratory and currently working in the Brewing Science & Technology platform, gave the PlantHUB consortium an introduction into the interesting history of Carlsberg as well as an overview of the Carlsberg research facilities. These include green houses for hops and barley, analytical laboratories and laboratories for microbiology and molecular biology purposes as well as a fully equipped pilot brewing plant including bottling facilities.



The PlantHUB consortium members in front of the Carlsberg Laboratory and the statue of its founder J. C. Jacobsen.

"The principal task of The Carlsberg Laboratory shall be to develop as complete a scientific basis as possible for malting, brewing and fermenting operations."

- J.C. Jacobsen, founder of Carlsberg

Dr. Knudsen also shared some insights into the current research focus at Carlsberg Research Laboratory, such as enhanced flavour stability. Carlsberg further has the ambition to be the global brewer with the lowest consumption of water and energy per litre of beer produced. Therefore, another important research area is the development of new sustainable brewing processes.

After the guided tour through the research facilities, Dr. Finn Lok, Brew Master and Principal Scientist at Carlsberg A/S showed the PlantHUB consortium the historical laboratory, where in 1909 the Danish chemist S.P.L. Sørensen, head of Carlsberg Laboratory's Chemical Department, developed the pH scale.

His pioneering research has had a profound effect on beer and science. The pH scale has become the standard breweries use to determine the pH before pitching the yeast.

Dr. Lok's explanations were completed by a tasting of beers from the Carlsberg portfolio.



All PlantHUB fellows in the historic lab at Carlsberg: Mr. Anton Hochmuth (ESR2), Mr. Claudio Cropano (ESR3), Mr. Giacomo Potente (ESR5), Mr. Seydina Issa Diop (ESR6), Mr. Maximilian Vogt (ESR4), Mr. Camilo Chiang (ESR9), Ms. Mercedes Thieme (ESR1) and Mr. Florian Cueni (ESR10).

In summary, the third PlantHUB Annual Meeting offered an excellent opportunity to meet representatives of Carlsberg A/S on site and exchange on state-of-the-art breeding strategies and objectives.

CONCLUSIONS / OUTCOMES

The company visit to the Carlsberg Research Laboratory offered opportunities for insights into the research of crop improvement and brewing and into careers for plant scientists in the industry sector.

Testimonials from PlantHUB consortium members and fellows:

“The PlantHUB project was of benefit for Deutsche Saatveredelung AG, because it opened up the opportunity to learn about fast evolving technologies, which will impact in the future also plant breeding. The subjects targeting a better description of the phenotype of plants or improving the growth of plants are very interesting. In addition, the progress in the development of genome sequencing and assembling technologies is also of great importance for plant breeding.”

Michael Koch, Deutsche Saatveredelung AG, industry partner for ERS 3 and ESR4



Mr. Michael Koch (Deutsche Saatveredelung AG, Germany), Mr. Maximilian Vogt (ESR4), Prof. Bruno Studer (ETH Zurich, Molecular Plant Breeding) and Mr. Claudio Cropano (ESR3)

"The regular meetings of all PhD fellows allowed for a fruitful exchange about their personal experiences with academic research and industry. In addition, Camilo Chiang was in regular contact with ESR10 regarding plant growth and climate control in indoor growth facilities, since both ESRs used the same phytotrons for their experiments. Outside of the PlantHUB consortia, Camilo Chiang started a collaboration with the terraXcube research group of EURAC, Bolzano, Italy, where he contributed to improve the LED lighting system for the ecotron facility."

Günter Hoch and Camilo Chang (ESR9), University of Basel

"Projects within the PlantHUB consortium were very different and consequently the academic and industrial PIs had a very different skill set. As everyone involved is not only very knowledgeable in their respective field, but also very open and accommodating, I experience the PlantHUB participation as a true and sustainable expansion of my professional network. Especially the innovative approaches in sequencing technologies, genomics and genetics greatly benefit my current and most likely also my future research.

We have extended our collaboration with ETH Zurich in a written agreement recently."

Ilka Braumann, Carlsberg Research Laboratories, industry partner for ESR and ESR2



Ms. Mercedes Thieme (ESR1) and Prof. Samuel Zeeman (ETH Zurich, Plant Biochemistry).

“Within the PlantHUB consortium we have had many courses together and so we developed and learned new concepts as a group. During that process we have shared scientific and ethical views. It was a dynamic time, especially when all the fellows came together to one place and spend some days together.

I cooperate with Mercedes Thieme (ERS1) since the beginning of the project and together we have developed methods which helped both of us in our analysis. Furthermore, I have established a cooperation outside PlantHUB with people from DTU for one of my workstream. The DTU facility helps me to analyse my X-ray microtomography image data within the frame of a collaboration.”

Anton Hochmuth (ESR2), ETH Zurich and Carlsberg Research Laboratories



Mr. Florian Cueni (ESR10) and Mr. Issa Seydine Diop (ESR6)

“Doing my PhD-thesis as a part of the PlantHUB consortium was a very valuable experience for me. Through the program I met nine other PhD-student working in vastly different fields, which broadened my horizon in extremely important topics in current plant sciences. I also got to see how their projects get applied through their industrial partners, e.g. by visiting CLAB in Copenhagen.

While setting up a climate-controlled growth chamber experiment at the University of Basel, I cooperated with PlantHUB fellow Camilo Chiang. He helped me to adjust the LED-system of the chambers in order to emit the best light spectrum for flower and fruit production.”

Florian Cueni (ESR10), University of Basel and Agrosolab GmbH

“As consortium, the PlantHUB programme gives us the opportunities as fellows to discover and materise an innovative way to spark collaboration between academia and industries. Through visits, trainings, summer schools and workshops, I learned to take part in the reflection of complex problems such as the management of precise agricultural data, and the acquisition of fine skills in management and analysis of massive sequencing data.

PlantHUB was the optimal consortium offering unprecedented trainings to fellows, collaborations between academia and industries, in order to bring a beginning of solutions to global challenges like climate change, the implementation of a sustainable agricultural practice.

Through the PlantHUB programme, I acquire a deep understanding to the third-generation sequencing. The experience acquired have been consolidate by important training in multiple field of plant breeding and, new cutting edge technology for plants development. From the data generating during the project, the University of Zurich is collaborating with Baseclear to perform benchmarking for new algorithms for plant genome assembly.”

Issa Seydine Diop (ESR6), University of Zurich and BaseClear

"Being part of the PlantHUB network gave me the wonderful opportunity to discover how research is carried out in industries, compared to universities. Moreover, thanks PlantHUB an amazing collaboration started between Prof. Conti's and Prof. Studer's groups, because of a common scientific interest in plant reproduction. This resulted in a series of joint meetings the two groups are having, in which we present our latest results, exchange ideas and discuss problems together."

Giacomo Potente (ESR5), University of Zurich and BaseClear