

Promoting Plant Research in Sweden: observations from a PlantLink workshop

Att främja växtforskning i Sverige: iakttagelser från PlantLink-workshop

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On 15-16 March 2018, more than 60 plant researchers gathered in Lund for a lunch-to-lunch meeting on the future plant research in Sweden. The Director for PlantLink, Erik Alexandersson introduced the meeting and welcomed participants from both academia and the industry. Presentations were given on three themes: New Swedish plant research initiatives, Swedish plant research in an international perspective, and Outreach and how to build a strong network. The plants differed from oats to forest trees, and scales ranged from molecular to field scale studies. The meeting ended with a discussion on the potential to organize future Swedish Plant Biology days, led by Stefan Jansson from Umeå Plant Science Centre (UPSC) and Scandinavian Plant Physiology Society (SPPS). Karin Metzlaff from the European Plant Science Organisation (EPSO) provided experience from other Plant Biology meetings, and advised to formulate a clear mission for Swedish Plant Biology Days. After an interesting discussion, the meeting decided that the three main Swedish plant research intra-university collaborations UPSC, the Linnaean Center for Plant Biology and PlantLink will continue the discussion on future possible Swedish Plant Biology days. PlantLink thanks all presenters and participants for interesting presentations and active discussions.

During the first session, the diversity of Swedish plant research was presented in five different plant research initiatives.

Molecules in MaxIV, plant phenotyping and food

In the first presentation, ScanOats coordinator **Dennis Eriksson** gave a background to this industrial research center, which is funded by the Swedish Foundation for Strategic Research (SSF). Dennis told us about the long-term Scandinavian cultivation of oats, and the interest from consumers – oat consumption has increased by 73 % since 2000. On the scientific side, ScanOats is sequencing the genome of this hexaploid crop. ScanOats aims to promote a dynamic and entrepreneurial network. You can subscribe to their monthly newsletter at www.scanoats.se. ScanOats later organized the workshop “From idea to market” on 2 May 2018.

After ScanOats, we heard about Nordic and European plant phenotyping networks from **Erik Alexandersson**. **NordPlant** is a climate and plant phenomics hub for sustainable agriculture, with 5 Nordic university partners including Lund University and SLU, funded by NordForsk. The application was initiated by PlantLink. The focus of NordPlant (www.nordplant.org) is to build a network for plant phenotyping facilities, including data sharing. NordPlant will organize a kick-off event in Helsinki on 24-25 October 2018. A survey on Nordic phenotyping facilities for controlled conditions has just been accepted in *Review in Agriculture and food science: Nordic research infrastructures for plant phenotyping*. **EMPHASIS** is a European project for research on plant phenomes, the set of physical and biochemical traits belonging to an organism (<https://emphasis.plant-pheno>



Fig. 1 A large and active audience enjoyed the workshop.

typing.eu/). The objective is to develop an integrated pan-European infrastructure of instrumental plant phenotyping. Erik also presented the public-private-partnership project **6P/Nordic Plant Phenotyping Network (NPPN)** (<http://nordicphenotyping.org/>). They organize a field days and seminars as well as drive a number of research projects related to plant phenotyping

Edith Hammer thereafter told us about the exciting possibilities for plant-and-soil research at the Max IV facilities in Lund (<https://www.maxiv.lu.se/>). The Max IV slogan “Making the invisible visible” fits well with Edith’s research on tiny structures of roots, mycorrhizal hyphae and soil. We learned that spectroscopic and synchrotron analyses were used to study soil aggregates at the microscale. X-ray beams were used to scan surfaces for example calcium composition, and elemental maps were produced to show plant nutrition. By scanning the systems, 3-dimensional maps of soil and plant structure can be obtained. Other studies included salinity-stressed symbiosis, and elemental analysis relevant in toxicity studies. Edith showed amazing images of these structures. You are welcome to contact Edith if you wish to relate your research to Max IV (edith.hammer@biol.lu.se).

The Head of the Department of Food technology, engineering and nutrition at Lund University, **Yvonne Granfeldt**, thereafter gave

us interesting updates on the ongoing and many upcoming initiatives in the Food sector. The Lund University Food Studies (LUFO) is an umbrella organization for the whole food chain with members from all faculties except the Arts faculty. To sign up for their newsletter, access newsletter.lufo.lu.se. As part of this organization, the relatively new network LU Food Faculty is a forum to meet up with new research partners and prepare research applications. PlantLink is a partner here and researchers from both LU and SLU Alnarp are most welcome to the Food Faculty activities. You can join the network by emailing Charlotta Turner (charlotta.turner@chem.lu.se). Yvonne also told us about the international initiative for food safety DISH, the national platform Food Science Sweden that aims to strengthen Swedish food science research, and the graduate school programme LIFT.

Swedish forest biotechnology research

We thereafter turned to two presentations on the forest biotechnology programs at Umeå Plant Science Center (UPSC). **Stefan Jansson** from UPSC told us about the research on forest genetics and genomics on aspen, Norway spruce and Scots pine. The aspen genome is now submitted, and Stefan talked about the huge differences between aspen haplotypes and the enormous genetic varia-



Figure 2. Solveig Krogh Christiansen from University of Copenhagen presented their experiences from organizing The Plant Biology Days in Denmark.

tion in aspen. We saw the distribution of the impressive SwAsp collection, which started in 2004 and has localities all over Sweden. In addition, the UmAsp collection hosts 350 genotypes of aspen. Stefan also showed how one gene (FT2) was demonstrated to explain 70 % of the variation in bud set in the Swedish population. Stefan thereafter presented research on Norway spruce, which he viewed as a fairly undomesticated species compared to agricultural crops. The cycle of breeding and progeny testing currently takes 25-50 years in Norway spruce. Future research on spruce includes cooperation with Skogforsk and their spruce bud collection data. In addition, UPSC hopes to put genome sequence data together for Scots pine.

Ove Nilsson thereafter presented the research at the UPSC Berzelii center for Forest Biotechnology. Ove presented their prioritized projects on somatic embryogenesis for clonal forestry, nutrient uptake and trans-

genic trees with increased growth and better wood properties. For somatic embryogenesis, [SweTree Technologies](#) has developed an automated process to avoid the labour intensive process of dissecting embryos from elite seeds and letting them mature into new copies to produce identical progeny. Ove showed that the automated process is estimated to provide a 25-30 years quicker access to genetic gain, and the goal is to build a real factory by the end of 2019. The nutrient research is led by Torgny Näsholm and has led to an Arginine/Lysine fertilizer that provides better nitrogen use efficiency, and several new products were developed from this concept. We also heard about transgenic trees with increased growth and better wood properties. Since 2010, 126 genetic constructs had been tested in field trials, summing up to over 80 genes. Traits included growth, drought resistance, wood quality and phenology. Last year, a new Vinova competence centre was started at UPSC,

and will run to 2021. The research will focus on field trials. Other interesting projects Ove presented included electronic plants and a new large gene mining program to identify genes controlling growth and wood properties. One facility in use for this research is a new greenhouse with an automatic phenotyping platform, and international cooperation with the University of Gent in Belgium who work closely with agriculture biotech companies.

Plant science views from The European Plant Science Organisation

The European Plant Science Organisation (EPSO) is an independent organization with academic members from 31 European countries, and provides science advice to policy. Karin Metzlaff has been the executive director of EPSO since it started in 2001, and we were excited to hear her view of the status of plant science in Europe. Karin started by saying that plant science can help to address global challenges, and that EPSO wishes to make the link to food much stronger in the future, for example to improve the composition of plants for diverse diets. Another important topic was renewable resources and climate change where green bioactive molecules could play a role. In general, Karin saw lots of potential in plant research to look at the global sustainability goals. Karin also underlined the need to continue to invest in basic research. Today basic research is neglected, while in the past, the transition to products was neglected. Karin explained that curiosity-driven plant science fosters knowledge in the young generation about living organisms and the world we live in. Education action plans, University networks and interactions between scientists and entrepreneurs were actions encouraged by EPSO. As a part of encouraging the young generation to engage in plant science, EPSO hands out a young plant scientist award in 2018. EPSO has 10 working groups and provides information to plant scientists

for use in briefings, newsletters, job descriptions and national profiles. Find more information, access www.epsoweb.org. EPSO's ongoing activities include Strategic input to the Horizon 2020 FP9/mission concept, Food 2030, being and official observer at ERA-CAPS and ERA-SusCrop (Facce). Karin reported that the EPSO position on the next EU framework programme for Research and Technological Development is to strengthen collaborative basic research to close the research and innovation cycle. After a very informative presentation, Karin encouraged us to develop a national EPSO hub.

Plants in bioeconomy

Deniz Koca presented the definition of bioeconomy, and the role of plant science in bioeconomy. Based on the 2012 EU bioeconomy strategy, the trend in increasing demand for biomass will continue. The trends are driven by a growing global population and by consumption patterns. Deniz showed how bioeconomy may also generate severe negati-



Figure 3 PlantLink organized the workshop on promoting Plant research in Sweden

ve impacts on the environment and society, in terms of conversion of land, intensification of production and food security. This leads to concerns regarding design and end-of-life management. So what do we need to do? Deniz pointed towards a systems level redesign of the existing economic system and the socioecological regime. This would need innovation in business systems and legal frameworks, and a new institutional rearrangement that can interlink independently in addition to technological development. For this to occur, societal acceptance is needed. Since the start, the field of bioeconomy has been growth oriented, but Deniz sees a gradual change of narrative in the field, that involves other angles. The only way to achieve a systems redesign is to include all of society. Deniz coordinates a Formas-funded Bioeconomy graduate research school that acts as a collaborative learning platform across disciplines.

Ivar Virgin from Stockholm Environment Institute is a researcher and farmer. The mission of SEI is to bridge science and policy, and Ivar talked about what modern plant biosciences can do for bioeconomy. An interesting example was to increase efficiency in feed conversion systems by using tailor-made feed crops. In general, farmers are predicted to need to double production over the next 30 years to meet increased demand. Such a growing demand positive for farmers but there are challenges, such as water and a changing climate, soils and agricultural land, nutrients and labour. So how to meet all the increasing demands? Ivar talked about the need to develop crops that are more tolerant to climate change. An increase carbon uptake in soils is also needed, and Net primary production can be an important tool in offsetting climate change. We got interesting examples of the challenges in this area. In the area of agricultural suitability, Ivar saw the room for expansion of crop land as limited in many continents, but that Africa and Latin America might have some room for expansion. Current biomass utilization rarely

uses the full pot of crops, and Ivar called for ways to unlock the full potential of the products. Lots of technical solutions exist, but remain on the shelf. In Ivar's words: The future is here, but unevenly distributed and with narrow focus. Examples of success stories however exist, like the sorghum beer in Uganda, where production was greatly increased.

How to reach out about plants

After an intense first day, the Friday started with a great presentation on Characterization of sRNA populations in plant gametophytes by German Martinez Arias from SLU Uppsala. Thereafter, we listened to presentation under theme 3: Outreach, stakeholders and how to build a strong plant research network. Lisa Beste from Mistra Biotech, Bo Gertsson from Lantmännen Lantbruk and Anna Ekberg from Lund University Sustainability Forum provided insights on how to engage with stakeholders. The approaches varied from field visits, podcasts, and presence at policy events such as Almedalen annual political week. Lisa Beste presented the work she does with Anna Lehman for [Mistra Biotech](#), aiming at consumer attitudes. They work with a communication group that sets up a plan for communication. The podcast can be accessed at [shapingourfood.libsyn.com](#). The message from Bo Gertsson, Lantmännen Lantbruk, was that a strong local presence creates an advantage. Lantmännen Lantbruk has cereals as their focus area, and has a research foundation where the themes are Food and packaging, Agriculture and Bioenergy and biomaterials. Lantmännen Lantbruk also has [The Greenhouse project](#) to develop an idea or company. When Lantmännen Lantbruk engages in a research project, they need to be part of the dialogue from early on, and the aim is to make a difference for the agrofood business. Anna Ekberg presented how the Sustainability Forum works with the Global sustainability goals, and underlines that they cannot just be added on to a research application. Instead, Anna wants to see inter-

disciplinarity and collaboration, and that projects provide ways for different research areas to interact. An arena for this is provided by LU Sustainability forum, for example during the [Lund Sustainability week](#). Anna encouraged PlantLink to be part of the Sustainability week in the future, since all activities under this week are highlighted and broadcasted through the Sustainability forum channels.

Before the concluding discussion on the possibility of Establishing Swedish Plant Biology days, Solveig Krogh Christiansen from University of Copenhagen presented their experiences from organizing the annual meeting within [Plant Biotech Denmark](#). The Plant Biology Days in Denmark were created after an international evaluation concluded that Danish plant research was too fragmented. Solveig concluded that the same appeared to be true for Sweden. Solveig thereafter gave an overview of the organisation and work behind the work, and that the concept was successful and had now been going on for 14 years. Three important factors were that the meeting was reliable in the way that it occurs at the same time and place every year, it provided national networking, and it had a pragmatic steering committee. Solveig also provided information on the upcoming Plant Biology Europe 2018 meeting on 18-21 June in Copenhagen. She strongly encouraged young researchers to participate.

After these inspiring insights on how to reach out, build strong networks, and organize plant meetings, Stefan Jansson led an active discussion on the possibility of establishing Swedish Plant Biology days. Important points were the conflict of time and money that many researcher have, what the actual mission of the meeting was, and if the meeting should be national or Scandinavian – or alternating between the two which would be possible with the biannual Nordic SPPS meetings. Valuable advice from Karin Metzlaff was to set a mission on what should be achieved with this meeting – networking, meeting young scien-

tists, providing policy input or other aims. The discussion expressed an interest in a relatively short meeting in a neutral place that would provide an arena for networking. The meeting decided that UPSC, the Linnaean centre for plant science and PlantLink would continue the discussion on establishing Swedish Plant Biology days.

After this informative discussion, PlantLink thanked all presenters and participants for making this a very active and enjoyable workshop!

Sammanfattning

Den 15-16 mars 2018 samlades mer än 60 växtforskare i Lund för ett möte om den framtida växtforskningen i Sverige. Mötet organiserades av PlantLink i samarbete med SPPS (Scandinavian Plant Physiology Society). Teman på mötet var nya svenska växtforskningsinitiativ, svensk växtforskning i ett internationellt perspektiv och outreach och hur man bygger ett starkt nätverk. Växterna omfattade allt från havre till skogsträd, och studierna utfördes på molekylär- till fältskala. Vi fick bland annat höra om havregenet, växtforskning på Max IV-anläggningen, växtbaserad bioekonomi och framsteg inom näringssupptag i skogsträd. Mötet avslutades med en diskussion om möjligheten att organisera framtida svenska växtbiologidagar, ledd av Stefan Jansson från Umeå Växtforskningscenter (UPSC) och SPPS. Mötet föreslog att de tre svenska växtforskningsnätverken UPSC, Linnécentrum och PlantLink skulle fortsätta diskussionen om framtida möjliga svenska växtbiologidagar.



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