3nd SILVA doctoral student conference of the Faculty of Forest Sciences October 15th – October 16th

Conference venue: Best Western Plus Park city Malmö

Time schedule for October 15

09:00 – 09:10: SILVA: Opening of the SILVA doctoral conference

09:10 – 09:50: ***Keynote speaker***: **Gudmund Vollbrecht**: Mega drivers and how this might impact you as young researcher.

Gudmund Vollbrecht has a forestry background and did his PhD at SLU, Alnarp in 1994. He became associate professor in 1999 and has been adjunct professor through IKEA at SLU (2000 – 2005 & 2020 – 2021) and at Linneaus University (2012 – 2018). Gudmund has an extensive business experience working more than 20 years outside academia where he has had senior positions at IKEA and as CEO for Skogssällskapet. Currently, Gudmund is working at SLU as coordinator for Trees for Me, a centre of excellence working on fast growing broadleaves.

09:50 – 10:05: ***Keeli Curtis:*** *Information and advisory services in Swedish forestry*. Southern Swedish Forest Research Centre

FIKA:

10:35 – 10:50: ***Anna Karlsson:*** *Co-creating forest management plans for better implementation of landscape perspective on private estates.* Southern Swedish Forest Research Centre

10:50 – 11:05: ***Edward Carlsson:*** *Genomic Selection across generations in Norway Spruce.* Department of Forest Genetics and Plant Physiology

11:05 – 11:20: ***Derek Garfield:*** *A Leafy-green Future: Constructing Transition Pathways towards Broadleaf Forestry.* Southern Swedish Forest Research Centre

11:20 – 11:35: ***Laura García Romañach***: *A transcriptional roadmap of the yearly growth cycle in Populus trees.* Department of Forest Genetics and Plant Physiology

11:35 – 11:50: ***Tinkara Bizjak:*** *Norway spruce and Scots pine soil and endophytic needle fungal and bacterial communities in northern Swedish common garden experiment.* Department of Forest Genetics and Plant Physiology

11:50 – 12:05: ***Laura Tünnermann:*** *Plant organic nitrogen nutrition: costs, benefits, and carbon use efficiency.* Department of Forest Genetics and Plant Physiology

12:05 – 12:20: **Joel Jensen**: *Climate change mitigation through carbon sequestration in mixed tree plantations*. Department of Crop Production Ecology

LUNCH:

13:30 – 13:45: ***Isabell Rosenkranz:*** *Cold acclimation – a tug of war between transcriptional activation and repression.* Department of Forest Genetics and Plant Physiology

13:45 – 14:00: ***Getachew Gemtesa Tiruneh:*** *Nutrient budgets in short rotation black wattle (Acacia mearnsii) stands for charcoal production as compared with teff (Eragrostis tef) cultivation.*. Department of Soil and Environment

14:00 – 14:15 ***Özer Erguvan:*** *Ultra structural characterization of cell adhesion in plants*. Department of Forest Genetics and Plant Physiology

14:15 – 14:30**: Sezer Olivia Kaya**: *Assessing Weevil Damage in Silver Birch: Species Identification and Efficacy of Plant Protectants*. Southern Swedish Forest Research Centre

14:30 – 14:45: **Christian Höök**: *Advancing Semi-Automated and Automated Data Annotation for Computer Vision in Forestry*. Department of Forest Biomaterials and technology

FIKA:

15:30 – 16:45. Demo: Nordic Forestry Automation (NFA). AI-powered forest machine operator support system. According to NFA the AI powered system continuously detects, positions, measures and classifies all trees around the machine. It also measures the position and orientation of the machine and harvester head with cm-accuracy. Using this information, the system provides real-time feedback to the operator and a a full before/after inventory (of individual trees).

Time schedule for October 16

We start 08:15 from the hotel (Best Western Plus Park city Malmö). 08:30 we pick up some people from Malmö C, Norra Vallgatan, (bussfållan mitt emot Frans Suellstatyn). Then we travel to Skarhult Research Park where Martin Goude (Experiment Group Leader at the Unit for Field-based Forest Research) will guide us in some experimental sites there. Afterwards we will have lunch at the Skrylle Restaurang och café and then we will visit Trollskogen Vresbokarna och after that Dalby Söderskog National Park. Our guide there will be Tove Hultberg SLU, PhD alumni. She defended her thesis in 2015. The title was *The long-term history of temperate broadleaves in southern Sweden*.

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CONFERENCE ABSTRACTS

Information and advisory services in Swedish forestry

Keeli Curtis
Southern Swedish Forest Research Centre, Swedish University of Agricultural Sciences

Background

In Sweden, where there are few regulations on forestry, meeting forest policy targets mainly relies on informational policy instruments. However, there has been very little research that actually evaluates or problematizes the potential effectiveness of these services. Both private and public actors in the forest sector deliver advisory services in various forms, but there is no clear division of responsibility defined in Swedish forest policy. My PhD project looks into who provides advice, which forms of advice are available, and criticizes the desirability and feasibility of this arrangement.

Methods

I use the Forestry Knowledge and Information Systems (FOKIS) framework as an overarching frame for my analyses. This framework illustrates the relationships between advice providers, tools & processes, policy objectives, and forest owners in the Swedish context. My main data source is interviews with private and public advisory services professionals.

Main results

In my first paper I highlight the dual roles of timber buyers as key forestry advisors in southern Swedish forestry. I explore their degree of influence on the landscape relative to both forest owners and public advisors, finding that their position gives them unique possibilities to apply a landscape perspective, but that there are no incentives for them to work beyond the stand or property level.

Two of my articles focus on advisory services at the Swedish Forest Agency (SFA). One describes how digital advisory services have emerged both as a cause and effect of SFA's limited ability to provide traditional forms of advice. Digital advisory services are able to address broader audiences than traditional forms, but they are not suitable for providing opportunities for co-construction and co-production of knowledge. These different services can be synergistic with effective coordination. The other article examines how institutional and organizational barriers to advisory services at SFA can impede forest policy achievement. Organizational processes like how resources are distributed between departments, how activities are prioritized, and regional variations prohibit advisory services from being delivered at all, even though they are widely recognized as necessary for achieving forest policy goals.

Conclusion

Throughout my PhD, I argue that advisors and advisory organizations need more attention in research since they have direct influence on forest owner decision-making. My research contributes to a more holistic view of advisory services by examining Swedish FOKIS at a national level as well as examining the capabilities of different advice providers and the tools available to them.

Co-creating forest management plans for better implementation of landscape perspective on private estates.

Anna Karlsson, Vilis Brukas & Ola Eriksson
Southern Swedish Forest Research Centre, Swedish University of Agricultural Sciences

Background

Landscapes worldwide have become fragmented and degraded, posing a threat to biodiversity and ecosystems. In Sweden, companies or private forest owners orientated towards timber production for commercial purposes own most of productive forest. Thus, exclusive reliance on increased areas of set-asides for enhancing the status of forested landscapes would be costly and require an elaborate process to acquire acceptance. Rather, there is a need for approaches integrated into standard procedures for forest management and planning. The forest management plan (FMP) plays a vital role in Sweden's forestry, serving as an instrument for generating and implementing forest management alternatives. To effectively balance diverse objectives and consider different management options, including aligning estate management with landscape features, the current FMPs require improvement. Additionally, there is a need for advancing the planner's core capacity from production-oriented technical expertise to a wider skill-set, while matching the owner's multi-dimensional needs.

Methods

To address these needs, our study goes through three phases. First, we will conduct ethnographic observations of planning operations followed by semi-structured interviews with forest planners to examine their motivations, expertise, and planning procedures, including the accustomed ways to integrate the landscape perspective in FMPs. Second, we will create a low-cost, standardised method to assess how estate management affects landscape values. Finally, we are going to co-design novel planning procedures and pilot them on selected forest estates.

To achieve better consideration of biodiversity and multitude of ecosystem services in FMPs, we intend to produce procedural guidelines, a prototype plan that includes landscape features, and a training module for planners. Our approach is based on knowledge co-creation between scientists, forest planners and owners, enhancing the likelihood of practical implementation on a broader scale.

Genomic Selection across generations in Norway Spruce

Edward Carlsson
Umeå Plant Science Centre (UPSC), Department of Forest Genetics and Plant Physiology, Swedish University of Agricultural Sciences; & Skogforsk

Background

The efficiency of forest tree breeding suffers from long generation times. This is largely because breeders need to test their material at an appropriate age, old enough to predict performance at the age of harvest. Norway Spruce (*Picea Abies*) is the most economically important tree species in Sweden. In the Norway spruce breeding program in Sweden, the final age for evaluation in the field is around 15, and the total length of a breeding cycle is around 25 years. The best trees within each family are then selected as candidates for crossing, to create the next generation. By utilizing genomic selection, it becomes theoretically possible to make selections on genotyped but unphenotype trees, using data on the previous generation for model training. This opens the possibility to make selections already at the seedling stage, increasing the rate of genetic gain per unit of time.

Methods

16 clonal field trials were planted in the mid-south of Sweden. These contained the material from two linked generations, consisting either of unrelated plus-trees (G0) or 34 full-sib families (F1). Ca 41 000 trees were measured for height and more than ca 1000 clones from each generation were genotyped with a 50 k SNP chip, from which 40 000 high quality SNPs were selected. The marker data was used to construct a G-matrix of all genotypes. The raw data was subject to spatial-adjustment and within-site standardization. Several G-BLUP models were run with Asreml-R to calculate genomic estimated breeding values and narrow-sense heritability. Three cross-validation scenarios were set to make predictions of the F1 phenotypes using training on the G0 generation, using either all of the G0, only the direct parent genotypes selected to create the F1s, or a combination of parents and distant relatives revealed by the G-matrix. Additional scenarios were tested for comparison with predictions strictly within the F1 itself or a combination of G0 and F1. All scenarios were run with 100 iterations. Models were evaluated in terms of predictive ability and prediction accuracy when performing mass-selection and within-family selection.

Main results

The G-matrix revealed several inconsistencies in the pedigree, along with novel relationships within the plus-trees. Using only the parent genotypes achieved an average prediction accuracy of 0.28 compared to 0.15 when using the entire G0. However the prediction of genetic parameters such as additive variance was very poor, and the accuracy was partly inflated by the presence of a few exceptionally good families. Predictions of masked genotypes within the F1 generation gave an average accuracy of 0.49. Training on both generations resulted in very high accuracies, but when predictions were broken down to within only F1s of the test set, it was the same as when only training on the F1. Within-family selection models had essentially zero accuracy for all cross-generation scenarios. Within-generations, it was 0.07 and 0.10 for the F1 and both generations respectively.

Conclusions

- Using genetic markers can reveal hidden relationships in the pedigree.
- Mass selections across two generations using SNP data had a prediction accuracy of 0.15
- 40 000 SNP markers is too few to perform accurate within-family selection across generations.

A Leafy-green Future: Constructing Transition Pathways towards Broadleaf Forestry

Derek Garfield *and Magnus Hellgren*
Southern Swedish Forest Research Centre, Swedish University of Agricultural Sciences

Background

Birch and aspen are the two most common hardwood species by volume in Swedish forests and are some of the faster-growing native species. Both have a long history of use in Sweden, though in small-scale, niche applications, such as interiors of saunas, and parochial use as firewood, still a favored non-industrial use (Dubois et al., 2020; Woxblom and Nylinder, 2010). The predominant industrial use of birch and aspen timber is pulpwood for the paper industry.

The management of forests under CRFM has created a forest structure where broadleaf species tend to regenerate sporadically, with volumes interspersed in conifer-dominated stands (Axelsson et al., 2002; Drossler, 2010; Felton et al., 2010; Woxblom and Nylinder, 2010). Forest certification standard requirements for broadleaf ingrowth for the duration of the rotation have likely reinforced this phenomenon (Garfield and Brukas, Unpublished Manuscript). This leads to an intermittent flow of hardwood stock, challenging the ability of forestry companies to plan economically sound logistics around saw log quality hardwood timber, resulting in what little hardwood saw logs that might be remunerated at a higher price being sold as pulpwood in order to achieve profit for forest-owners.

Considering the broad relevance and the societal importance of the forest-based sector in achieving sustainability goals for the whole of Sweden, we argue that a research approach developed from the sustainability transitions literature is appropriate. A transdisciplinary, action research methodology is therefore adopted for this paper. Loorbach et al.'s (2017) review of the sustainability transitions literature confirms participatory visioning as a key method for the governance of transitions. This study aims to engage a broad range of stakeholders from forestry and forest-based industries in describing transition scenarios that assume a transition towards broadleaf forestry.

Methodology

Transition scenarios are defined as “participatory explorations of possible development trajectories that incorporate a structural systems change towards a desired, sustainable future state of the system” (Sondeijker et al., 2006). Some qualitative foresight research and policy analysis in a Swedish forest context has already been done (Sandström et al., 2020, 2016), but none focus on a specific sustainability issue as suggested by the transition management literature (Loorbach, 2010; Loorbach and Rotmans, 2010).

We begin with a questionnaire in which stakeholders are asked to consider what a desirable goal and timeframe is for achieving a transition towards broadleaf forestry. Based on the variables identified by the participants, we outline the scenarios based on the aggregated inputs using a classic uncertainties matrix to generate four distinct scenarios.

In a workshop, we then engage in backcasting (Quist and Vergragt, 2006) pathways *OR* SWOT analysis *OR* Three Horizons framework for each scenario to create descriptions of strategies for achieving a successful transition. Participants are asked to engage with each scenario and develop a strategy for achieving it. Participants should identify key resources, internal and external, needed to be successful and achieve the desired outcome of the vision.

Results

The results describe the four scenarios and typify them, discuss the pathway and strategies, as well as present some of the variety expressed by the participants, including commonly shared approaches but also radical departures from the mainstream.

Discussion

Following (Sandström et al., 2020), we will discuss the implications of the developed pathways towards broadleaf forestry for current policies governing forestry and make suggestions for how these might be adapted to better align with the described pathways. Particular attention will be given to the highest-rated scenario and pathway. Discuss how our results compare to (Sandström et al., 2020).

A transcriptional roadmap of the yearly growth cycle in Populus trees.

Alice Marcon[1], **Laura García Romañach**[1], Domenique André[1], Nicolas Delhomme[1], Torgeir Hvidsten[2], Ove Nilsson[1]

[1]Umeå Plant Science Centre (UPSC), Department of Forest Genetics and Plant Physiology, Swedish University of Agricultural Sciences; [2]Faculty of Chemistry, Biotechnology and Food Science, Norwegian University of Life Sciences, Ås, Norway

Background

Boreal forests are essential in regulating global climate and mitigating the effects of climate change[3]. Plants growing in this climate must face diverse environmental conditions with drastic changes in temperature, light, and water availability. Perennial plants have developed specific mechanisms to protect their meristems before the coming winter, which consist of growth cessation, establishment of dormancy, and development of cold hardiness[1,2]. In many tree species, the shortening of day length in late summer and early autumn triggers the termination of elongation growth and stops the emergence of new leaves in the shoot apical meristem (SAM). This leads to the formation of an apical bud, which encloses the leaf primordia and the SAM by protective bud scales[1,3,4]. At the beginning of the winter, trees enter dormancy (a state similar to deep sleep), where they are unresponsive to environmental signals. As winter progresses, this state of dormancy is then released, and warmer temperatures will reactivate growth in late winter or early spring. This can be observed by the swelling of buds, which leads to the development of new leaf primordia and the formation of new leaves, and the growth cycle is then repeated. Therefore, the growth cycle in trees can be divided into four stages: growth cessation and bud set, establishment of bud dormancy, release of bud dormancy, and bud burst and active growth.

Methods

We present a characterization of the major changes in the transcriptome of *Populus* trees (*Populus tremula* and *Populus tremula* x *tremuloides*) throughout the yearly growth cycle. We have sampled different tissues in several conditions and have performed RNA-Seq analysis.

Main results

By pooling all this data, we have managed to group genes in modules according to their expression pattern, and we have created a general co-expression network. Several key transcription factors have been identified in every stage of the yearly growth cycle in *Populus*. This data will be publicly available as a resource to the scientific community, along with an app that will help the users navigate the dataset.

1. *Maurya JP, Bhalerao RP (2017) Photoperiod- and temperature-mediated control of growth cessation and dormancy in trees: A molecular perspective. Annals of Botany 120:351-360*
2. *Nilsson O (2022) Winter dormancy in trees. Current Biology 32 (12):630-634*
3. *Pohjanmies T, Trivino M, Le Tortorec E, Mazziotta A, Snall T, Monkkonen M (2017) Impacts of forestry on boreal forests: An ecosystem services perspective. Ambio 46 (7):743-755*
4. *Singh RK, Svystun T, AlDahmash B, Jonsson AM, Bhalerao RP (2017) Photoperiod- and temperature-mediated control of phenology in trees - a molecular perspective. New Phytologist 213 (2):511-524*

Norway spruce and Scots pine soil and endophytic needle fungal and bacterial communities

Tinkara Bizjak
Umeå Plant Science Centre (UPSC), Department of Forest Genetics and Plant Physiology, Swedish University of Agricultural Sciences

Background
Soil and plant-associated microbiotas, mostly fungal and bacterial communities, play a crucial role in plant health and stress tolerance of forest soils and trees. The bacteria and fungi are present in the bulk soil, the interface between soil and plant roots, on and inside different plant tissues. However, very little is known about these communities, their composition and establishment in the boreal forest. In other environments, diverse factors have been shown to affect the composition and diversity of microbial communities, among those especially soil properties and plant species effect. Using a common garden experiment allows for the analysis of the plant species effect as it limits the variance due to nearly identical soil, environment and climate conditions. The main aim of the study was to describe simultaneously the fungal and bacterial microbiome of Norway spruce and Scots pine soil and needle tissues using the unique common garden setup. The study looked into differences in microbiomes between the two different conifer species and different environmental niches (soil compared to endophytic needle community).

Methods
Soil and needle samples were collected from Scots pine and Norway spruce plots in around 30-year old common garden experiment in Vindeln, northern Sweden. Needle samples were surface sterilized to only analyse their endophytic microbial communities. The fungal and bacterial communities were analysed using full-length ITS and 16S sequences, respectively. After DNA extraction and library preparation, the samples were sequenced on the PacBio platform at Maryland Genomics, USA. The obtained data was preprocessed by trimming, filtering, denoising, removing chimeras and generating ASVs. Relative abundance analysis, α-diversity, β-diversity and differential abundance analysis were performed on either non-normalised or rarified datasets using R.

Results
Based on the α- and β-diversity, the fungal and bacterial communities differed between Scots pine and Norway spruce samples showing plant species effect on the microbial community composition. There was also a significant difference between the two different environmental niches, as the soil and endophytic needle fungal communities did not share any common ASVs. Additionally, we did not observe a core microbiome between different samples as only a few ASVs were shared between most of the samples.

Conclusions
The study showed that there is a plant species effect on the composition of fungal and bacterial communities as they were significantly different between the Scots pine and Norway spruce plots. Additionally, there was a significant difference between soil and endophytic needle communities, indicating that the needle endophytic community is unique and composed of fungi from diverse sources. A better understanding of the boreal forest fungal and bacterial community composition and factors affecting it could lead to more sustainable forest management better equipped to cope with increasing biotic and abiotic stresses in the future.

Plant organic nitrogen nutrition: costs, benefits, and carbon use efficiency

Laura Tünnermann[1#], Camila Aguetoni Cambui[1#], Oskar Franklin[2,3], Patrizia Merkel[1], Torgny Näsholm[1,3] and Regina Gratz[1,3*]

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Background

Soil nutrients are critical elements for plant growth and productivity. Nitrogen (N), in particular, is a limiting factor for primary production in most terrestrial ecosystems. Furthermore, nitrogen nutrition, its growth-promoting effects, and the importance for plant biomass allocation, when applied in its inorganic forms such as nitrate or ammonia, are well known. For a long time, the importance of inorganic N was highlighted in the scientific community and led to increased utilization of inorganic N fertilizers, which negatively impacted the environment. However, in the last decades, the focus shifted away from inorganic N as sole important N source towards organic N forms such as amino acids (AAs). In this study, I will focus on organic N in form of AAs and try to identify the effect of AA treatments on plant growth and biomass production.

Method

Different growth systems were developed to analyze the effect of organic and inorganic N sources on plant growth, shoot:root allocation, and nitrogen uptake of *A. thaliana* Col-0 plants. The usage of a split root system served to identify the influence of organic (glutamine) and inorganic N sources (nitrate) on the same plant. The plants were treated with the different N sources nitrate, glutamine (Gln) or both and were then analyzed regarding their 15N and 13C status, biomass, and root length.

Results

Here we demonstrated that Gln, affects plant growth positively, when used as sole N source, and leads to a distinctive plant phenotype, characterized by increased root biomass, compared to inorganic N treatment. Besides the effect on the root biomass, we observed positive effects of Gln on the presence of root hairs and on the N uptake of plants compared to inorganic N. Interestingly, similar responses could be observed when the plant was treated with a combination of organic and inorganic N. The observed phenotypic characteristics of Gln grown plants resemble those of N deficient plants which raises the question of the existence of a specific amino acid phenotype.

Outlook

Based on these results, we try to identify the role of carbon (C) provided by organic N and its effects on plant growth and development. We suggest that the observed phenotype was congruent with a significant contribution of C derived from organic N.

Climate change mitigation through carbon sequestration in mixed tree plantations

Joel Jensen
Department of Crop Production Ecology, Swedish University of Agricultural Sciences, Sweden

Background:
Mixed-species forests have gained attention as a potential pathway to mitigate the impacts of climate change and improve forest ecosystem resilience. Compared to monocultures, mixed-species forests tend to provide a wider range of ecosystem services, including increased productivity and carbon (C) sequestration. The mechanisms behind these benefits, however, remain poorly understood and highly context-dependent. Prior research has demonstrated that species composition, functional trait expression, and plant-soil-microbe interactions all play critical roles in shaping ecosystem functions such as C storage. Given these complexities, this research aims to investigate how tree diversity influences above- and belowground C sequestration, exploring the role of species identity and composition as well as environmental context in modulating these effects.

Methods:
To evaluate the impact of tree diversity on soils and species interactions, data was sourced from a global network of tree diversity experiments called TreeDivNet (https://treedivnet.ugent.be/). These experiments spanned a variety of tree species mixtures and environmental contexts, with the number of experiments varying across studies. Annual tree inventories, targeted functional trait and soil sampling effort yielded datasets which allowed for the examination of relationships including species richness, functional traits, fungal communities, climate and both above- and belowground C stocks.

Main Results:
Species identity emerged as a stronger driver than species richness in influencing soil C sequestration and soil organic matter chemistry in mixed willow experiments in Sweden and Germany. Despite this, no clear negative impact of species richness on soil C sequestration or soil organic matter chemistry was observed.

Across 10 experiments in Europe and Brazil, higher tree species richness generally led to greater C accumulation in the topsoil, particularly in areas with lower soil fertility, cooler temperatures, and less climatic variability. Although tree mixtures did not directly increase fungal diversity, an indirect relationship between tree diversity, soil C stocks, and fungal diversity suggests that fungal communities may play an important role in C sequestration in diverse forests.

Tree diversity was also found to enhance stand productivity, particularly in functionally and structurally dissimilar mixtures, based on data from 22 global experiments. Our data showed that the positive diversity effects on productivity were largely due to high-performing species included in the mixtures, and that these species can be characterized by more acquisitive functional traits, such as high leaf nitrogen content and/or low wood density. Preliminary findings indicate that species mixing influences community functional expression, with traits such as specific leaf area and leaf nitrogen content increasing in more diverse stands. Additionally, canopy cover (leaf area index) and biomass (litterfall) were found to be higher in mixed-species stands compared to monocultures. Further analysis is underway to assess whether functional traits can be used to predict changes in aboveground biomass in response to species diversity.

Conclusion:
This research demonstrates that tree species diversity enhances both above- and belowground C sequestration at broader scales. Functional and structural diversity are important mechanisms driving these effects, and that their influence is modulated by environmental conditions. These findings highlight the potential of mixed-species forestry as a tool for climate change mitigation and emphasize the importance of species composition in optimizing forest management strategies.

Cold acclimation – a tug of war between transcriptional activation and repression

Isabell Rosenkranz
Umeå Plant Science Centre (UPSC), Department of Forest Genetics and Plant Physiology, Swedish University of Agricultural Sciences

Background:
The climate is changing, making us experience harsher weather conditions and drastic temperature changes. Plants are particularly affected because of their sessile lifestyle. They have therefore mastered their responses to stress through internal pathways in which transcriptional regulation plays a key role. The CBF dependent signaling pathway, in which the C-repeat/dehydration-responsive element binding factors (*CBF*s) are the main regulators, is tightly controlled. The gene *CBF1* is downregulated by an antisense long non-coding RNA, named *SVALKA* (*SVK*). *SVK* gets activated a few hours after cold exposure and leads through RNA Polymerase II stalling to the release of immature *CBF1* mRNA. *SVK* however, might be regulated by an upstream Transposable element that includes a methylation site. A switch in usage of Transcription Start Sites was observed after a few hours of cold exposure, making *SVK* an even more interesting target to study.

Methods & main results
While *SVK* is a down-regulator of *CBF1*, we are also interested in activators of *CBF* transcription. The highly conserved protein AGO1 can bind small non-coding RNAs with a size of 21 – 24 nucleotides that can guide the protein to complementary areas in the genome. For a long time, the only well-known function of AGO1 was post-transcriptional regulation in the cytosol by RNA interference. Recently, AGO1 was found in the nucleus, binding to chromatin. After cold exposure, we observed a higher binding frequency of AGO1 to the chromatin in the *CBF* region. Additionally, a cluster of sRNAs associated with AGO1 was found in the same region. Understanding the role of AGO1 in trans-activation of stress-responsive genes such as the *CBF*s is the goal of this research project. To prove the concept of AGO1 being an important link in the chain when it comes to stress response, we want to show that genes activated by AGO1 after stress exposure can be switched on in control conditions if correct sRNAs are present.

Conclusions
This concept should be applicable to many stress responses in different plant species, since AGO1 is conserved throughout eukaryotes and involved in several stress responses.

Nutrient budgets in short rotation black wattle (Acacia mearnsii) stands for charcoal production as compared with teff (Eragrostis tef) cultivation.

Getachew Gemtesa Tiruneh
Department of Soil and Environment, Swedish University of Agricultural Sciences

Background:
High market demand for charcoal has led to a rapid land use change from cropland to short-rotation forestry (SRF) using black wattle (Acacia mearnsii) in northwestern part of Ethiopia.

Methods
This study investigated the sustainability of the land-use change through comparing nutrient budgets for the black wattle plantations with teff (Eragrostis tef) cultivation, the main food crop previously grown in the area. Two harvest scenarios were considered for the A. mearnsii: whole biomass harvest (WBH), representing the current practice, and leaves retained on site (LRS) as an alternative management strategy.

Main results
The results showed that the A. mearnsii under both WBH and LRS leads to a net negative nutrient budget for P, K, and S. Furthermore, A. mearnsii resulted in 115% and 60% higher net export of base cations compared to *E. tef* under WBH and LRS, respectively. However, N fixation contributed 183 kg ha^{-1} y^{-1}, which resulted to a net increase in N budget under LRS. The combination of increased N in soil and export of large quantities of base cation will lead to increased soil acidification.

Conclusions
The finding underscore the need for sustainable management strategy including less intense harvest, recycling of ash and possibly fertilization of P and S. Liming will also be necessary to sustain cultivation in the area, as the pH has shown a significant decrease. Compared to the WBH, the LRS approach is less nutrient depleting, although it still results in higher nutrient depletion than teff cultivation.

Ultra structural characterization of cell adhesion in plants

Erguvan, Ö.[1]*, Heymans, A.[1], Atakhani, A.[1], Gascone, E.[3] Ali, O.[3], Verger, S.[1,2]
[1]Umeå Plant Science Centre, Department of Forest Genetics and Plant Physiology, Swedish University of Agricultural Sciences; [2]Umeå Plant Science Centre (UPSC), Department of Plant Physiology, Umeå University; [3]Laboratoire Reproduction et Développement des Plantes, Université de Lyon, ENS de Lyon, UCB Lyon, CNRS, INRAE, INRIA, F-69342, Lyon, 69364 Cedex 07, France.

Background

Cell-cell adhesion is a fundamental feature of multicellular organisms. In plants, cell-cell adhesion is mediated by the cell wall surrounding the cell. In other words, when we scale down to the cellular level, adjacent cell walls are linked to each other through a middle lamella which is believed to be very important for cell adhesion. However, it is still unclear what structural role the middle lamella plays in this process and whether other structures of the cell wall are involved. A precise characterization of cell-cell adhesion in plants is still lacking.

Methods & main results

To address this, we employ various microscopy techniques, including Confocal Microscopy, Atomic Force Microscopy (AFM) and cryo-Scanning Electron Microscopy (cryo-SEM), Transmission Electron Microscopy (TEM) alongside computational simulations to assess the biological significance of our findings. Here, I will highlight our recent observations where we identify cell wall ultra structures at the outer epidermal edges of intercellular junctions using these combined microscopy techniques. These features appear to play an important role in keeping epidermal cell adhesion. Additionally, I will highlight their potential contribution to overall tissue cohesion through computational simulations of cell wall mechanics.

Assessing Weevil Damage in Silver Birch: Species Identification and Efficacy of Plant Protectants

Kaya, Sezer Olivia; Matsiakh, Iryna; Cleary, Michelle; Additional authors to be determined
Southern Swedish Forest Research Centre, Swedish University of Agricultural Sciences

Background
Forests are vital to reducing reliance on fossil fuels, yet challenges to forest health are escalating due to climate change and pest outbreaks. In Sweden, silver birch (*Betula pendula*) is increasingly considered an alternative to Norway spruce and Scots pine, particularly in light of their vulnerability to pests and diseases. However, recent observations in southern Sweden have identified significant damage to newly planted silver birch seedlings caused by weevils. Notably, previous studies have indicated that *Betula pendula* is targeted by pine weevils, even when their primary food source, pine, is available.
This study aims to (i) identify the extent of weevil damage on newly planted birch seedlings and the weevil species responsible, (ii) assess the variation in damage between fresh and one-year-old clear-cut sites, and (iii) evaluate the effectiveness of the plant protectant Woodcoat® in reducing seedling mortality.

Methods
The field trial started in spring 2024 at the Tönnersjöheden experimental park in Halland, Sweden, involving weekly monitoring of damage and mortality in newly planted seedlings across various treatment groups throughout the summer. Seedling heights were recorded at both the start and end of the growing season. Damage and mortality monitoring, along with height measurements, will be repeated in 2025 to assess whether weevil damage differs between the first and second years after planting.

Main results
The results are still being analysed and will be supplemented with additional data following the seedling monitoring in 2025. However, preliminary findings suggest a significant difference in mortality rates and bark damage caused by weevils between treated and untreated seedlings, with untreated seedlings experiencing notably higher damage and mortality in both fresh and one-year-old clear-cut sites. By the end of the insect activity period in 2024, none of the treated seedlings exhibited bark damage at the base where the treatment was applied. Across both site types, the predominant weevil genera found were *Strophosoma*, *Otiorrhynchus*, and *Hylobius*. While morphological identification of these species was attempted, DNA analysis will be conducted for confirmation at the species level. *Strophosoma* and *Otiorrhynchus* were primarily observed feeding on leaves and petioles, whereas *Hylobius* spp. consistently targeted the root collar as well as the bark along the stem of the seedlings. These observations may suggest that *Hylobius* spp. could be the main contributors to bark damage, while *Strophosoma* and *Otiorrhynchus* may primarily contribute to leaf damage.

Conclusions
The findings from this project will equip forest stakeholders with essential insights to make informed decisions on birch management and provide practical guidance on mitigation strategies to reduce losses and ensure the long-term viability of birch plantations.

Advancing Semi-Automated and Automated Data Annotation for Computer Vision in Forestry

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Background
The application of computer vision (CV) in forest operations offers significant potential to enhance automation and operational efficiency. However, the limited availability of high-quality annotated image datasets remains a key obstacle to developing robust CV models. This PhD project addresses this gap by developing scalable methods for image annotation, while also exploring synthetic data augmentation and advanced automation techniques to improve CV model performance.

Methods
In the initial phase, we introduce a semi-automated method that integrates harvester operational data with video footage to generate images of trees and logs that are paired with relevant data extracted from the harvester records. Following this, we aim to replace manual annotation processes with fully automated workflows using open-source state-of-the-art foundational models, significantly reducing the need for human intervention. Additionally, the project explores the impact of synthetic data augmentation on increasing dataset variability, enhancing the generalizability of CV models. The culmination of this research will synthesize these approaches into a comprehensive framework for large-scale, automated dataset creation and CV model development in forestry.

Main Results
The initial testing of the semi-automated method demonstrated a significant reduction in annotation time and complexity while maintaining data quality and accuracy. This approach proved effective in rapidly generating annotated images that align with the operational data. Future efforts will focus on deploying open-source foundational models to fully automate the annotation process and evaluating the role of synthetic data augmentation in improving the adaptability of models to diverse forestry environments.

Conclusions
This research introduces practical methods to streamline image annotation for CV applications in forestry, both through semi-automated processes and by exploring fully automated solutions. The exploration of synthetic data expansion aims at enhancing dataset variability, which may lead to more resilient CV models that can better handle rare edge cases and challenging conditions in forestry environments. These approaches aim to support more efficient data handling and model development, contributing to advancements in forestry operations.