Workplan for Master’s thesis Workplan for Josephine Connelly Date: wed 5th oct 2022 Working title: Soy Adapt

Project description:

SoyAdapt: adaptation of soybean to the northern climate

Background

Soybean (Glycine max) is the most widely grown legume, which global cultivated area constitutes about 6% of agricultural land world-wide. Due to its high protein and oil content and nutritional value, soybean plays an important role in agriculture, food, cosmetics, chemical and pharmaceutical industries. Even though soybean production in Europe increased in recent years, to 2.7 Mt, EU-29 needs to import approx. 40 Mt each year. The yearly consumption of soy in Denmark is about 1.5 Mt which corresponds to an area measuring over 400.000 ha mainly in Argentina and Brazil. In order to reduce the climate footprint associated with soybean import and re-introduce it in crop rotation of European agriculture, there is an ongoing effort in Central and Eastern Europe to increase soy cultivation. However, research into the potential of expansion of the crop to a range of thermal and photoperiodic conditions does not extend to latitudes of Nordic Countries. Soybean is a short-day, thermophilic plant; thus, through its sensitivity to photoperiod and thermal requirements, natural geographical distribution is limited to a relatively narrow latitudinal range which currently does not include Denmark. Therefore, photoperiod and cold tolerance traits are key factors determining adaptation of soybean varieties to Nordic conditions.

Available resources for the project*

- Polymorphism data (SNPs) from whole-genome resequencing of genebank accessions, at 10x depth (work in progress).
- 160 soy bean genebankaccessions insensitive to photoperiod.
- 414 soybean genebank accessions from high-altitude regions in Asia (cold tolerance).
- Whole-genome sequence data on 17 soybean diverse accessions for pan genome analysis (Liu et al.2020).

Goals

The vision for the introduction of soybean in a region outside of its optimal cultivation range must be supported by strong basic research focused on understanding the effect of genomic variation and population genetic analysis. The goals are to: (i) understand the evolution of the soybean accessions and (ii) understand their cold and photoperiod response.

Analyses

Population genetic analyses are tremendously valuable for answering questions ranging from applied to basic evolutionary questions. Population genetics seeks to understand how and why the frequencies of alleles and genotypes change over time within and between populations. The analysis could include:

- Where is the center of origin of the cold and photoperiod insensitive accessions?
- Did soybean populations go through genetic bottlenecks during cold adaptation?
- Are soybean populations structured by region, geography, micro-environment, etc.?
- Are there signatures of selection in soybean genomes, and what do they reveal about the evolutionary history of that species?
- (Other questions, e.g., related to demographic history, gene functions, impact of mutations, etc.) .

Pan genome analyses could include identification of unique genomic regions in the photoperiod insensitive and cold tolerant accessions.

- Detailed characterization of genomic regions involved in photoperiod response across cultivated and wild accessions: DNA substitutions and structural variations (e.g., presence-absence of genes).
- Functional characterization of signatures of domestication and selection during soybean breeding.
- Comparison of evolutionary signatures with known QTL from other peer-reviewed studies.

Reference

Liu, Y., Du, H., Li, P., Shen, Y., Peng, H., Liu, S., Zhou, G.-A., Zhang, H., Liu, Z., Shi, M., Huang, X., Li, Y., Zhang, M., Wang, Z., Zhu, B., Han, B., Liang, C., & Tian, Z. (2020). Pan-Genome of Wild and Cultivated Soybeans. Cell, 182(1), 162-176.e13. https://doi.org/10.1016/j.cell.2020.05.023

Plan for supervision:

- If you have more than one supervisor, there ought to be an agreement on the roles of the individual supervisors regarding planning of the project, the experimental phase and in the writing process. Who will mainly be responsible for the scientific content in the project? Supervisors are Wolf Eiserhardt, Bioscience, Natural Sciences. Role: Guillaume R
- The project work is divided between more than one location,

- Can include a description of the supervision, e.g. frequency and number of meetings with supervisor etc.
- Can include a description of the level of affiliation with the research section. Discuss with you supervisor, if you are expected to participate in section meetings, journal club, seminars with other students in the section or other activities during your Master's project period?
- Find advice on matching expectations with your supervisor in the section: "Good advice regarding your thesis process". Timeline: Must include an approx. timespan for the individual phases in your project Start date: 1 september 2022 Submission date: 15. june 2023 Completion date: 30. june 2023 Link to gant chart: https://docs.google.com/spreadsheets/d/1NSvrSAg-TkY427UOzbjuwG8mRS2tH9FO1LBo-pG_a4g/edit?usp=sharing

Project Planner Template		Task	months	PROGRESS	PLAN START	PLAN END
Thesis			1-10	10,00%	1/9/2022	30/6/2
Searching for and reading literature		Reading	1-5	20,00%	1/9/2022	30/12/
Learning and making pipeline		Data	2-5	0,00%	1/10/2022	1/2/20
Data analysis		Data	3-9	0,00%	1/11/2022	1/3/20
Visualisation and figure making		Data	4-7	0,00%	1/1/2023	1/2/20
First section	Review	Writing	2-5	0,00%		
First section	Methedology, Hypothesis, Discussion	Writing		0,00%		
Second Section, Scientific manuscript	Introduction	Writing	5-6	0,00%		
Second Section, Scientific manuscript	Methods	Writing	3-7,9	0,00%		

Second Section, Scientific manuscript	Results	Writing	4-9	0,00%		
Second Section, Scientific manuscript	Discussion	Writing	6-9	0,00%		
Exam presentation		Exam	10	0,00%	16/6/2023	1/7/20

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First section	Methedology, Hypothesis, Discussion	Writing		0,00%		
Second Section, Scientific manuscript	Introduction	Writing	5-6	0,00%		
Second Section, Scientific manuscript	Methods	Writing	3-7,9	0,00%		

Second Section, Scientific manuscript	Results	Writing	4-9	0,00%		
Second Section, Scientific manuscript	Discussion	Writing	6-9	0,00%		
Exam presentation		Exam	10	0,00%	16/6/2023	1/7/20

Project-specific competences: • You can include a list of competences that you expect to achieve during the project period besides the official learning outcomes stated in the course description for the master's thesis ("Thesis – Biology", AU course catalogue). Suggestion for project-specific competences:

- Familiarity with the software programme (name) and unassisted be able to (task)
- Thorough familiarity with (method) and ability to evaluate ... in relation to ...
- Be able to use (apparatus) unassisted / under supervision to analyse … Remember to check regularly that you are on track to fulfil the official learning outcomes and project-specific competences during the project period. Link to official learning outcomes.