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Skolkovo Institute of Science and Technology

Jury Member Report – Doctor of Philosophy thesis.

Name of Candidate: Alina Chernova

PhD Program: Life Sciences

Title of Thesis: Integrating high-throughput genotyping and lipidomic profiling for discovery of genetic determinants of cultivated sunflower seed oil content

Supervisor: Professor Philipp Khaitovich

Name of the Reviewer: Professor Laurent Gentzbittel

I confirm the absence of any conflict of interest (Alternatively, Reviewer can formulate a possible conflict)	**Signature:**  **Date: 29-12-2020**

The purpose of this report is to obtain an independent review from the members of PhD defense Jury before the thesis defense. The members of PhD defense Jury are asked to submit signed copy of the report at least 30 days prior the thesis defense. The Reviewers are asked to bring a copy of the completed report to the thesis defense and to discuss the contents of each report with each other before the thesis defense.

If the reviewers have any queries about the thesis which they wish to raise in advance, please contact the Chair of the Jury.

Reviewer's Report

Reviewers report should contain the following items:

- Brief evaluation of the thesis quality and overall structure of the dissertation.
- The relevance of the topic of dissertation work to its actual content
- The relevance of the methods used in the dissertation
- The scientific significance of the results obtained and their compliance with the international level and current state of the art
- The relevance of the obtained results to applications (if applicable)
- The quality of publications

The summary of issues to be addressed before/during the thesis defense

The Doctoral thesis by Alina Chernova describes the analysis of three collections of sunflower varieties based on HT genomics and lipidomics profiling methods. Insights

The thesis is well written and include all necessary chapters–abstract, introduction, material and methods, results, and discussion. The thesis includes also a comprehensive list of cited literature.

Alina Chernova used state-of-the-art mass spectrometry based technology to address lipid compositions at the level of complex lipids as well as free fatty acids in sunflower seeds. This is a quite interesting methodological approach. Coupled to genetic analysis of sunflower varieties, the work is in an attempt to provide insights into the genetic control of these important traits. The long-term goal is likely to produce tools to help for more efficient breeding.

Chapter 2 presented a good review of the literature on the subject area. The reviewer would have benefit from some synthetic and critical review of the literature to provide additional insights, the current text being too descriptive to some extent.

Chapter 3 presented material and methods. The laboratory methods are well explained, with the required level of precision to be able to reproduce the results. Bioinformatics or statistical methods would have benefit from more details and developments to reinforce confidence in the edited results. The field trials raise some interesting questions.

Chapter 4 described the analysis of the genetic diversity and of some phenotypic diversity within an important Russian collection of VNIIMK. The results of GWAS for two traits are presented, a reduced subset of the large number of different phenotypes that were recorded. A more detailed analysis toward the identification of a gene for fertility restoration in a sunflower diversity panel provided by a breeding company provided confirmatory results. As a whole, these results may open the possibility to develop molecular tools to help breeding via Marker Assisted Selection.

Chapter 5 provided a comprehensive and technical analysis of lipidome profiles in sunflower and some comparisons with rapeseed. Notwithstanding its clear technological interest, the research questions in this chapter are not very apparent for a scientist who is not a biochemists or a specialist of lipids. In particular, the value added of these methods in breeding programs (costs, practical aspects, throughput, repeatability, relationships with breeding targets or market demands) would have been interesting to develop.

Chapter 6 provided a detailed analysis of a large collection of sunflower lines, with the aim to provide understanding of the genetic bases of lipidomics patterns. A recent method of UPLC-MS was used to carry out the detailed analysis of the profiles. A large number of different lipids and fatty acids were identified. The genetic control of the quantity of some lipids or fatty acids was described. It would have been interesting to try to combine the information using some multivariate methods for example. The provided results may be very important but need additional studies and replications to be validated. In particular, the experimental design did not allow evaluating environmental variation with enough details. The fact that open-pollination of plants was allowed (chapter 3, section 3.4.1 page 40) – and thus the genotype of the seed being

possibly different from that of the mother plant - raises some interesting questions about the mapping of the phenotype of the seed fatty acid profile to the genotype of the mother plant if cross-pollination occurred during the field trials.

This large experimental work already allows publishing four papers and one submitted manuscript. These are notable achievements.

The thesis is probably among the first, ambitious initiative to implement lipidomics and GWAS in sunflower on a large scale in Russia. The work provides a clear view of the potential of these methods, even if it might suffer for some conceptual issues likely not attributable to the candidate. Overall, I truly enjoyed reading the thesis of Alina and I recommend this thesis for the formal defense.

Provisional Recommendation

☒ *I recommend that the candidate should defend the thesis by means of a formal thesis defense*

☐ *I recommend that the candidate should defend the thesis by means of a formal thesis defense only after appropriate changes would be introduced in candidate's thesis according to the recommendations of the present report*

☐ *The thesis is not acceptable and I recommend that the candidate be exempt from the formal thesis defense*