REVIEW

on a thesis for acquiring of a scientific degree "Doctor of Sciences" in the domain of higher education 6. Agricultural Sciences and Veterinary Medicine, professional field 6.5. Forestry, scientific specialty Forest plantations, breeding and seed production

Author of the thesis: Assoc. Prof. Krasimira Nikolova Petkova – Tsokova, Ph.D.

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Topic of the thesis: "Potential for adaptation of Douglas Fir and Common Beech provenances to climate change.

Reviewer: Dr. Petar Zhelev Stoyanov, Professor – University of Forestry, Forestry, Forest genetics, tree breeding and seed production.
Appointed as a member of the scientific jury with an order № 636/28.11.2019 of the Rector of UF.

1. Brief introduction of the author

Assoc. Prof. Dr. Krasimira Petkova graduated from the Higher Institute of Forestry (now University of Forestry, UF) in 1981. From 1981 to 1988 she worked in the field of forest management planning in Agrolesproject. Since 1988, after winning a competition, she enrolled at the UF as an Assistant Professor in Forest Plantations. In 1989 she defended her Ph.D. thesis and is 2001 she was promoted as Associate Professor. Her work includes serving two terms as Deputy Dean of the Faculty of Forestry.

2. Relevance and importance of the problem

Although there are controversies among the experts on the main and contributing factors causing climate change, it is a fact, and questions about the adaptation of natural ecosystems are a major scientific challenge. The thesis submitted for review is aimed at exploring the possible transfer of provenances of two important tree species - one native and one introduced – in relation to climate change, and this emphasizes the relevance and importance of the work. In

addition, both species are particularly important from an economic point of view, which makes research on them even more significant.

3. State of the art and interpretation of the literature survey.

The content of the thesis is well balanced. After a 2-page introduction, a 45-page literature review is presented, and finally, without being separated as a different part, the purpose and tasks of the thesis are given.

The objects of study and the method of work are presented on 22 pages, and the results and their discussion – on 79 pages. The conclusions and recommendations are on 3 pages, and the list of cited literature – on 32 pages.

The literature review is very detailed and covers virtually all topics discussed in the thesis. The problem of climate change is presented, as well as the experience gained with provenance trials of Douglas Fir and Common Beech in Europe, as well as critically comprehending the more important literary sources, which served as a basis for formulating the objective and tasks of the dissertation. The impression from the literature review is that Prof. Petkova knows in detail all the problems and issues related to the adaptation of Coastal Douglas Fir and Common Beech to climate change and the studies that have been carried out on these issues.

4. Objective, tasks, hypotheses and methods of research.

As mentioned above, the objective and tasks of the study are formulated at the end of the literature review. Although not identified in a separate part of the dissertation, they are a logical consequence of the review of the studies performed and of the conclusion which issues have not yet been investigated or have not been sufficiently investigated. The objectives and tasks are realistic and their implementation would contribute to a sufficient degree of clarification of the controversial and under-studied issues related to the testing the provenances of the two target species.

The objects of study are two geographical cultures of Douglas Fir and three - of Common Beech. A detailed characterization of the ecological conditions of both the areas of the provenance trials and the areas of natural provenances is presented.

A wide range of methods have been used to accomplish the tasks, some of which are applied for the first time in Bulgaria. The variety of methods is also determined by the different traits analyzed. Phenological observations have been developed for the relevant species of ocular rocks. The survival rate was analyzed by the third year in all experiments, and in some of them periodically at a later age, too.

Growth and productivity in height, diameter and volume, as well as mechanical stability, have been studied in particular. The mean diameter is determined on the basis of a basal area, and the mechanical stability is determined only for the provenance trial at the Petrohan UOGS.

Climatic data in relation to the phenological and biometric parameters studied are analyzed in detail. For the beech experiments, Ellenberg coefficient for each origin was calculated and, based on this coefficient, the average ecological distance was calculated, reflecting the combined influence of climatic factors.

The modern statistical processing of data makes an impression. A non-linear logistic model was used to analyze the phenological data in beech. Different statistical analyses – ANOVA, regression, and correlation analysis are applied, as well as a specific method for overcoming the problems that occur with overlapping variations of different sets of a given trait (the so-called ABC method).

The general impression is that for the purposes of the study, the author mastered and applied a variety of methods, which made it possible to obtain reliable results.

5. Visualization and presentation of the results obtained.

The presentation of the results is logical and consistent. In the main text, the results are presented in 32 tables and 55 figures (many of which are colored) that are the most necessary, and without them reading and comprehension of the text would be difficult. In addition, 7 schemes (designs) of the experiments are presented in the appendix, together with 2 tables and 9 pictures, which carry significant information.

6. Discussion of the results and the references.

The results obtained were analyzed and commented firstly, in the context of the objectives and tasks set, and secondly, in relation to other results of such studies. This work of the author was facilitated by the fact that both target species – Douglas Fir and Common Beech – are among the

most studied tree species in North America and Europe, respectively, and Douglas Fir is a widely studied species not only within its natural range, but also in the regions where it is subject to introduction. The availability of a large number of studies has allowed the results obtained in the present dissertation to be compared with other studies of this kind, and thus a much deeper and more comprehensive interpretation, commentary and conclusions can be drawn.

The total references are 355, of which 56 are in Cyrillic and 299 in Latin. It is noteworthy that about 180 publications, i.e., more than half of them are from the last 10 years – from 2010 (incl.) to date, which indicates that the author is aware of the latest achievements in the field of research and the obtained results in her studies have been interpreted in the light of recent research.

7. Contributions of the thesis.

The contributions made can be classified first, as scientific and applied, and second, as concerning each of the two species studied. The methodological contributions sub-category can also be distinguished in the group of scientific contributions.

7.1. Scientific contributions

The influence of environmental factors on the phenological traits of the provenances has been established, with proven significant differences among the provenances and groups of provenances.

A longer growing season has been demonstrated in the local provenances of the Common beech, and a geographical trend of variation of some phenological indicators has been recorded.

Significant differences are found in the survival rate of the provenances in the different provenance trials, but they were mainly due to damage by biotic and abiotic factors (for Douglas Fir) and to environmental conditions (for Beech), and to a lesser extent to differences among provenances.

Significant differences in growth rates were found between coastal and continental provenances of Douglas Fir. The best provenances for future plantation establishment have been identified. The importance of long-term experiments is emphasized, as a number of fast-growing provenances change their rank over time.

Local beech provenances express superior growth and productivity in comparison to introduced ones, which, however, show high vitality and adaptability to local conditions. The

response of different provenances to the combined effect of climatic factors, expressed by the Ellenberg coefficient and the eco-distance is not straightforward and too complex.

Methodological contributions are expressed in the application and analysis of the results of certain specific statistical approaches to data analysis, such as the non-linear logistic model, ABC method, the application of the Ellenberg coefficient and the eco-distance, as well as the development of regression models for the impact of climatic factors on Douglas Fir height growth.

7.2. Applied contributions

Applied contributions are those that allow the results to be applied into practice. It is sometimes difficult to separate them from the scientific ones. Such contributions are as following ones:

- Establishing the fact that Kazanlak (Shipka) 'local' provenance in terms of growth and productivity shows results above the average, and therefore, it can be considered promising.

- Identified best provenances for different trials that can be used for establishment of forest plantations.

- The established fact of the high plasticity of local Beech provenances, which could adapt to unpredictable changes in the environment, incl. and climatic.

- Correction of the limit of the perceived limit value of the mechanical stability of the Douglas Fir.

- and others.

Based on the studies conducted in the dissertation, logical summaries, conclusions and recommendations have been drawn. The contribution report reflects the most important points, although it could be expanded.

8. Evaluatuion of the author's personal participation in the contributions.

Generally, the personal contribution of the author of a D.Sc. thesis is very significant, since in this case he or she usually designs and directs the establishment of the experiments, organizes the measurement and data gathering and processing. This is entirely true of the author of the peer-reviewed thesis – the experiments were planned and designed in theory and under the direction of Assoc. Prof. Petkova, she directs almost all the studies, and organizes collecting and processing of data; she plays a leading role in summarizing the information and writing the publications. She is

a single author to three of them, in seven others she is a first author, and in three is the second author.

9. Critical remarks

As a participant in the preliminary discussion of the dissertation, I had the opportunity to make notes, questions and recommendations that were taken into account by the author. Therefore, I have no critical comments or questions in this review.

10. Published articles and citations.

Total 13 articles have been published in various scientific journals and proceedings of scientific conferences. Five of the articles have been published in scientific journals with Impact Factor and/or SJR (refereed by Web of Science and Scopus). Six articles have been published in other scientific journals and two – in proceedings of scientific conferences. The publication record of Assoc. Prof. Krasimira Petkova fully meets the requirements for the degree of Doctor of Science, stipulated in the Law on the Development of the Academic Staff in the Republic of Bulgaria and the Regulations for the Development of the Academic Staff at the University of Forestry.

The articles have been cited a total of 38 times in international scientific journals, in conferences, dissertations. This shows that the scientific community is well aware of the research results of Assoc. Prof. Petkova and appreciates them.

The abstract presented objectively reflects the structure and content of the dissertation. I will not comment on it here, as I have sent a preliminary review of the dissertation in which I clarify this issue in detail.

CONCLUSION:

Assoc. Prof. Krasimira Petkova's thesis is written at a high scientific level. The long-time work done, including the establishment of experiments, field research, data processing, summary and analysis of results, demonstrate the author's scientific and professional background. Along with traditional and well-established methods, she has been able to learn and apply new methods, some of which for the first time in our country. My overall impression of the thesis allows me to conclude that it fully meets the requirements of the legislative documents.

Therefore, I can recommend to the Scientific Jury to vote positively and to award Associate Professor Krasimira Nikolova Petkova-Tsokova a D.Sc. degree in the domain of higher education 6. Agricultural Sciences and Veterinary Medicine, professional field 6.5. Forestry, scientific specialty "Forest plantations, breeding and seed production".

12.02.2020
Sofia

Reviewer:
Professor P. Zhelev, Ph.D.