



## REVIEW

on a dissertation for scientific degree "Doctor of Sciences" in domain of higher education "6 Agricultural sciences and veterinary medicine", professional area "6.5 Forestry", scientific specialty "Forest plantations, breeding and seed production".

Autor of dissertation: Assoc. Prof. Krassimira Nikolova Petkova, PhD  
Department of Forestry at the University of Forestry – Sofia

Theme of dissertation: Potential for adaptation of Douglas-fir and Common beech provenances to climate changes.

Reviewer: Prof. Alexander Haralanov Alexandrov, DSc. – Department "Agricultural and Forestry Sciences" at the Bulgarian Academy of Science (BAS), domain of higher education "6. Agricultural sciences and veterinary medicine", professional area "Forestry", scientific specialty "Forest plantations, breeding and seed production". Member of Scientific jury according to Order of Rector of the Forestry University - № ZPS – 636/ 28.11.2019.

### 1. Brief biographic information about the applicant.

Krassimira Nikolova Petkova was born on 16 June 1958 in Vidin. She completed the Secondary education in 1976 at PG "Dimitar Blagoev" in her native town. He graduated from the Higher Institute of Forestry, specialty "Forest management" in 1981 with average scores Excellent (5.78) and of Diploma work – Excellent (6.00) (Diploma – VLT, series АЯ № 006502/30.03.1981). From 1981 till 1988 she was specialist – designer at IPPGSS "Agrolesproect" – Sofia.

Since April 1988 till 1990 she was Assistant Professor and till 2001 – Chief Assistant Professor in the Department of Forestry at the Faculty of Forestry. PhD dissertation on "Breeding of Douglas-fir (*Pseudotsuga menziesii* (Mirb. Franco) in some regions of the Balkan mountain" she defended in 1989 and the Higher Certifying Commission (HCC) awarded her the scientific degree "candidate of agricultural sciences (HCC – Diploma № 19919/20.03.1990). The academic position "Associate professor" HCC awarded her on 12 February 2001 (Certificate № 20570/23.04.2001). Since August till October 2012 she specialized in the Technical University – Munich and the Bavarian service of forest–seed production and breeding – Teizendorf, Germany.

Assoc. Prof. Krassimira Petkova has been a head of 4 research projects and a participant of 17 projects. She was deputy dean of Faculty of Forestry during 3 mandates (2005-2011 and 2013-2016), secretary of section "Forestry and Technical Sciences" at the Union of Scientists in Bulgaria (2009-2017) and member of the Faculty of Forestry (2001 - ). She uses 3 foreign languages: German, Russian and English.

### 2. Actuality of research problem.

The climate changes have influenced the life on the Earth since millions of years and have determined the trends of its development. During the last decades are originated contradictory hypotheses for these changes both for coming warming up and cooling of atmosphere and changes in ocean streams, but the existence of climate changes are no doubt. As concerned to forests it is

necessary to carry out research for the influence of these changes on forest populations in different models and alternatives. Big attention is paid to use of reproductive materials from forest tree genetic resources both for native and introduced species, particularly at climate stress.

The present dissertation makes a study on adaptation of one native tree species – *Fagus sylvatica* L. and one introduced tree species – *Pseudotsuga menziesii* (Mirb.) Franco at climate changes in the country. This study represents a part of the national silvicultural contribution to the Intergovernmental Panel on Climate Change (IPCC) and the World Meteorological Organization (WMO) in 1888.

### 3. Knowledge rate on the state of the problem and creative interpretation of literary survey.

The literary survey in the dissertation of Assoc. Prof. Krassimira Petkova is on the base of 355 publications, from which 259 – in English, 56 – in Bulgarian, 28 – in German, 4 – in Polish, by 2 – in Serbian and Rumanian, by 1 – in French, Danish, Slovenian and Turkish language. The author of dissertation has made use of scientific works, published in authoritative silvicultural journals as: *Silva Genetica*, *Forest Genetics*, *Forest Ecology and Management*, *Forestry*, *Tree Physiology*, *The Forestry Chronicle*, *Sylwan*, *Journal of Forest Science*, *Global Change Biology*, *Bioscience*, *New Forests*, *Annals of Forest Science*, *Journal of Balkan Ecology*, *Climate Research*, *European Journal of Forest Research*, *Scandinavian Journal of Forest Research*, *Phytopathology*, *Dendrochronology*, *Sylva Balcanica*, *Tree Genetics & Genomes* and others. Above all the results of series of articles of European Cooperation in Science and Technology (COST) Action 52 – “Genetic Resources of European Beech for Sustainable Forestry” as well as of publications of European Forest Genetic Resources (EUFORGEN) are discussed and compared. She is acquainted with the methods and studies of dozen Bulgarian and foreign dissertations as well as the most essential monographs and proceedings on the theme from Bulgaria, Germany, Switzerland, Spain, Czech Rep. and the USA. Enumerated journals and articles in monographs and proceedings, cited in dissertation of Assoc. Prof. K. Petkova show that she knows very well the state of investigated problem and she made constructive interpretation in literary survey. From total 355 cited publications, 182 publications (51%) are from the last 10 years, whereas 35 (10%) – from the last 3 years (2017, 2018, 2019), that spells including of contemporary knowledge on the theme till last months before final presenting of dissertation.

### 4. Aim, purposes, hypotheses and methods for research.

The aim of research is formulated in the dissertation heading: Potential for adaptation of Douglas-fir and Common beech provenances in geographic plantations to climate change.

The dissertation purposes are reduced to 7 ones as follows:

- Study on phenological response of *Pseudotsuga menziesii* (Mirb.) Franco and *Fagus sylvatica* L. provenances at different climatic conditions, compared with mother stands.
  - Survival of provenances as criteria for adaptation.
  - Growth in height and diameter as criteria for adaptation to climate change.
  - Modelling of growth in height of investigated provenances.
  - Possibilities for transference of Common beech provenances from Bulgaria to Germany.
  - Mechanical stability of Douglas-fir provenances to some abiotic factors.
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-Productivity of Douglas-fir provenances to the conditions of Northwest Bulgaria.

The study was carried out in created by her experimental plantations from *Pseudotsuga menziesii* (Mirb.) Franco and *Fagus sylvatica* L. by block method. The phenological features of Douglas-fir are determined by Kleinschmit et al. (1974) scale while of Common beech – by Forstreuter (2002). The climatic indices are collected from corresponding meteorological stations, prognoses data – from EURO-CORDEX (SUSTREE, 2018), while the average ecological distance (delta E) is determined by the Ellenberg coefficient.

The statistical processing of the results is carried out by dispersion analysis (ANOVA), regressive analysis (linear model on first power, linear model on second power, summarized linear model, not linear logistics model), ABC analysis and correlation analysis.

#### 5. Visualization and presenting of obtained results.

The results of this study are very well visualized and presented with 32 tables, 55 figures and 10 supplements – containing 7 schemes for geographic plantations in EFFE “Petrohan”, SFE “Berkovitsa”, SFE “Vidin”, SFE “Varbitsa” and SFE “Kotel”, 2 tables for survival of Douglas-fir provenances as well as 9 photos of studied sites.

The colouring of graphics for different provenances and those for temperature and relative air humidity in geographic plantations outline the studied processes.

#### 6. Discussion of results and utilized literature.

The results of phenological and morphological features of *Pseudotsuga menziesii* (Mirb.) Franco and *Fagus sylvatica* L. provenances, their survival, growth in height and diameter depending on some climatic factors and mechanical stability are discussed both separately and entirely and their reliability is mathematical well founded.

Further more the obtained results are compared with these of other researchers in large scope literature of use. It includes and publications on the program COST-E 52 with participants – well known European researchers on *Fagus sylvatica* L. as G. von Wuhlisch, C. Matyas, M. Forstreuter, H. Muhs, D. Gomory, J. Matras, D. Billian, L. Paule, J. Frydle and others. The results for *Pseudotsuga menziesii* (Mirb.) Franco in the dissertation are compared with these ones of known researchers as R. Lines, M. Konnert, J. Kleinschmit, J. Lexer, E. Popov, V. Lavadinovic, V. Isaev and others.

#### 7. Contributions of dissertation.

##### 7.1. Scientific contributions.

-A method for differentiation of three not-crossing classes in height of Douglas-fir: A, B, C corresponding to high, average and low values is created.

-It is established that with age increase the most slow-growing provenances keep their rank.

-It is determined a negative correlation between the stem volume and the altitude of examined Douglas-fir provenances.

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-It is confirmed that Douglas-fir provenances from Pacific Ocean coast begin a vegetation later on compared with Continental ones and they have a higher percentage of survival than Pacific Ocean provenances.

-The run of phenological phases with Bulgarian *Fagus sylvatica* L. provenances showed an ecological differentiation.

-It was found out a linear dependence between phenology phases in flushing and autumn leaf colouring of Common beech - on the one hand and geographic latitude and longitude – on the other hand.

-It is confirmed that the Bulgarian beech provenances come into flushing earlier than these in Germany.

#### 7.2. Scientific – practical contribution.

-Douglas-fir provenances “Darrington” and “Newharlem” of Cascade mountains in the USA are the most adapted to some climatic conditions in Bulgaria where they reach the most big productivity.

-From studied Bulgarian provenances “Berkovitsa” and “Petrohan”, and German ones – “Silberbach” and “Ebersdorf” of Common beech at conditions of geographic plantations in SFE “Varbitsa” leading on survival at age 3 years are “Ebersdorf” and “Berkovitsa”, while in SFE “Kipilovo” – are “Petrohan” and “Ebersdorf”. As concerned to growth in height at age 8 years leading in both geographical plantations is provenance “Petrohan”.

-The survival of Common beech provenances depends on moisture regime and for criterion it is possible to use the Ellenberg coefficient, which values have to be lower than 30.

#### 8. Evaluation of extent of personal participation of the applicant in the contributions.

The geographical plantation from 55 provenances, made in 1990 in EEFE “Petrohan” at 600 m a. s. l. is a work of Prof. Slavcho Iliev (1933-1995) and Assoc. Prof. Krassimira Petkova, while this of 29 provenances (20 – from Germany, 6 – from the USA and 3 – from Bulgaria) made in 2006 in SFE “Berkovitsa” at 850 m a. s. l. is a work of Assoc. Prof. K. Petkova.

The three geographic plantations from 8 Common beech provenances (5 – German ones and 3 – Bulgarian ones) made in 2010 in SFE “Vidin” at 200 m a. s. l., SFE “Varbitsa” at 350 m a. s. l. and SFE “Kipilovo” at 500 m a. s. l. are created by Assoc. Prof. K. Petkova.

The phenological and morphological investigations, the studies on survival, growth, mechanical stability and productivity of the provenances are personal work of the applicant.

#### 9. Critical notes and recommendations.

-According her story: “The most heat 30 years from the last 1400 years in Northern hemisphere have been registered for the period 1983-2012” (page 6) probably is refer to the last 140 years, when meteorological measurements were carried out.

-The number of replications for Douglas-fir provenances in EEFE “Petrohan” in 1990 is only 2, but it is recommendable to be bigger – 3-4 replications.

- The longitude of introduced Douglas-fir provenance “Kazanlak” is indicated with negative value (-25,3; -25,4) (page 55).

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-The phenological data for Douglas-fir provenances at nursery conditions in 2005 (page 73) is desirable to supplement with phenological data for this species in geographic plantations.

-In future studies on adaptation of forest tree species provenances to climate changes in Bulgaria it is necessary to include *Picea abies* (L.) Karst. – autochthonous coniferous species with similar ecological requirements of *Fagus sylvatica* L., forming high productive and steady mixed forests.

-The common point score of the applicant by group of indicators – D (Citations) in table 2 of applied documents is strongly reduced to 120 points instead of 405 available.

10. The published articles and citations.

On the dissertation work are published 13 scientific articles, from which 9 – are cited in 38 publications.

11. Evaluation of publications on dissertation work: number, character of journals where they are published. The reverberation in science – use and citation by other authors.

Out of referred 13 publications on the dissertation Assoc. Prof. Krassimira Petkova is the only one and first author of 10 publications and second author of 3 publications as 6 – are in English, 4 – in Bulgarian and 3 – in German language. They are published in established scientific journals as *Allgemeine Forst-und Jagtzeitung* (IF 2014 – 0.681), *Sylvae Genetica* (IF 2017 – 0.277), *Journal of Forest Science* (SJR 2014 – 0.343), *Austrian Journal of Forest Science* (SJR 2008 – 0.199), *Forestry ideas* (SJR 2018 – 0.103), *Silva Balcanica*, *Forest Science* (BG), *Scientific works of UF* (BG), *Scientific proceedings on Forestry in Germany and Bulgaria*. It means that a big part of her publications are in journals with impact factor and rank.

The publications on Dissertation are cited in 11 Bulgarian and 27 foreign issues, from which 15 with IF and SJR, as well as in monographies, proceedings and PhD theses, and this indicates scientific interests towards the specific studies.

12. Compliance of the submitted documents and materials of the applicant with those required under the Regulations for scientific degree in the University of Forestry.

The minimum required point score by groups of indicators (A, B, G, D) for “Doctor of Sciences” in professional area “Forestry” is 350 (50+100+100+100), and Assoc. Prof. Krassimira Petkova has 666 points (respectively 50+100+111+405) i.e. she exceeds nearly two times the necessary minimum point score for this scientific degree, due mainly to the higher value of indicator Citations (D).

The submitted essay reflects objectively the structure and content of dissertation but I would recommend some single style corrections.

#### CONCLUSION

Based on the scientific and applied contributions, the suitable methods of studies, the right carried out experiments, the discussion of results and conclusions, I consider that the presented dissertation work complies with the requirements of the Law for development of academic staff and the Regulations of the University of Forestry for their application, that give me ground to evaluate it positively.

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I suggest to Scientific Jury to vote affirmatively and to confer a scientific degree "Doctor of Sciences" to Assoc. Prof. Krassimira Nikolova Petkova in domain of higher education "6 Agricultural sciences and veterinary medicine", professional area "6.5 Forestry", scientific specialty "Forest plantations, breeding and seed production".

3 January 2020

Reviewer:

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/Prof. Alexander H. Alexandrov, D.Sc./