

## REVIEW REPORT

on a competition for the academic position “**Associate Professor**” in a professional field 4.3. **Biological Sciences**, scientific specialty “**Genetics**”, announced in SG № 24/17.03.2023, for the Laboratory “**Genome Dynamics and Stability**”, Institute of Plant Physiology and Genetics – Bulgarian Academy of Sciences (IPPG-BAS)

*Candidate:* **Georgi Nikolaev Bonchev**, PhD, Assistant Professor in the Laboratory “Genome Dynamics and Stability”, IPPG-BAS

*Reviewer:* Associate Professor **Irina Ivanova Vaseva**, PhD, Laboratory “Regulation of Gene Expression”, IPPG-BAS

Dr. Georgi Bonchev is the only candidate for the announced competition. The presented documents for participation in the procedure are prepared according to the legal requirements and are in line with the Regulations for acquiring scientific degrees and holding academic positions at IPPG-BAS.

### *1. Scientific career*

In the period 1990-1993, Dr. Georgi Bonchev was enrolled as a student in the Department of Plant Genetics at the Faculty of Biology of the State University in St. Petersburg. In 1995, he obtained a Master's degree in “Biotechnology” with a study profile on “Genetics and cellular engineering” at the Faculty of Biology of Sofia University “St. Kliment Ohridski”. The candidate began his scientific career as an assistant researcher in 1999 in “Molecular Genetics” Department of the Institute of Genetics of the Bulgarian Academy of Sciences. Later, after the restructuring of the scientific units within the Academy, Dr. Bonchev became part of the “Genome Dynamics and Stability” Lab at IPPG-BAS, working in the field of plant genetics with a particular focus on genetic markers. In 2011, he obtained a **Ph.D. Degree** in “Genetics” with a Doctoral Thesis “**Molecular-genetic characterization of sphaerococcum-type mutant forms in *Triticum aestivum* L. and *Triticale* using transposons**” (scientific supervisors: Prof. D.Sc. Sevdalin Georgiev and Prof. Dr. Lyubomir Stoilov). In 2015, Dr. Bonchev acquired a position of Assistant Professor, and since December 2017 he is the **Head of the “Genome Dynamics and Stability” Lab** at IPPG-BAS.

The candidate demonstrates a very good record of **international mobility** listing a “**Marie Curie**” **scholarship** to study molecular biomarkers as indicators of abiotic stress at the University of Sussex (2005) and **SCIEX postdoctoral position** at the “Evolutionary Botany” Lab of the University of Neuchatel to investigate “The link between transposon dynamics, heat response and climate adaptation”. In the period 2014-2019, Dr. Bonchev has had **three working assignments as a visiting researcher** in the Department of Genetics of the Faculty of Natural Sciences, Comenius University, Bratislava to study domestication of *Hordeum* and *Triticum* species using genetic marker approaches.

Dr. Bonchev's research expertise is in the field of plant population genetics and genome dynamics and his methodological toolbox comprises statistical, molecular, and bioinformatic analyses. In his work he applies genetic marker-based approaches utilizing DNA barcoding,

SSR, AFLP, transposon markers (SSAP, IRAP and REMAP). As IPPG-BAS representative, he is a member of the Scientific Council of the International Barcode of Life (iBOL) consortium. Since 2022 Dr. Bonchev represents the Institute in the BIOSCAN Europe Network within the iBOL consortium.

## 2. General research metrics

The candidate participates in the competition with a total amount of **857** points, which **significantly exceeds the required minimum** score of 540. The presented indicators for the fulfillment of the minimum national requirements for occupying the academic position "Associate Professor" at IPPG-BAS (described in Table 1 of the Regulations) are:

**Group A** (Ph.D. Thesis) – **50** points

**Group B** (scientific publications indexed in Web of Science and Scopus) – **100** points (required minimum 100 points)

**Group C** (total publication activity) – **234** points (required minimum 200 points)

**Group D** (citations) – **132** points (required minimum 100 points)

**Group E** (which summarizes project activity) – **341** points (required minimum is 70 points). The candidate has the highest score on the indicators described in.

**Details on Groups B and C:** The candidate presents **23** publications, of which 20 are full research papers and 3 are review articles. Two of the listed manuscripts (No.21 and No.22) are related to the Ph.D. Thesis so they should not be considered in the competition. Twenty articles from the list are published in journals with an impact factor. Their distribution by quartiles (designated with "Q", JCR or SJR ) is as follows: **9** publications have **Q1**, **5** are with **Q2**, **3** with **Q3**, and **3** with **Q4**. The candidate is listed as the first author in **11** of the papers (9 of them participate in the competition). The total JCR IF of the listed publications according to **Table 1** is **47.248**. The information on JCR IF for publications No.1, No.4, and No.8 in the MDPI journal Plants (IF=4.658, 2021) is missing (most probably due to a technical mistake). Therefore, the recalculated total JCR IF of all publications is higher than indicated – **61.222**. Three of the listed papers (No.16, No.20, No.22) are published in journals that are not included in the Web of Science (WoS) and Scopus databases. Dr. Bonchev provides information on deposited DNA Barcode profiles and genetic sequences in publicly available databases like the Barcode of Life Data System (BOLD) and the National Center for Biotechnology Information (NCBI).

**Details on Group D:** According to the information provided by the candidate there have been found **66** citations (mainly by international authors) of **13** of his publications (Web of Science/Scopus check has been dated 04/10/2023). However, there is a tendency for a rapid increase in this indicator, as the current number of citations is already **100**. The review paper "**Transposable elements and microevolutionary changes in natural populations**" published in the journal *Molecular Ecology Resources* has been cited **52** times (checked on 06/24/2023 Clarivate WoS).

**Details on Group E:** The candidate includes detailed information on his track record, comprising project activities and participation in national and international scientific forums and training programs emphasizing on active collaborations, professional development and research outreach. Dr. Bonchev was involved in 7 national programs and research projects funded by the Scientific Research Fund and the Ministry of Education and Science. He also has participated in 3 research projects funded by the International Atomic Energy Agency (IAEA Vienna). He

coordinates a project **BULCode** funded by the National Program "European Scientific Networks" of the Bulgarian government, the Ministry of Education and Science. IPPG has received significant financial support as a beneficiary (**956 925 BGN**) and substantial part of these funds were used to upgrade the research equipment of the Institute, thus contributing to its improved technical capacity.

Dr. Bonchev has presented **8 oral presentations** and has **co-authored 10 posters/conference lectures** in a number of scientific meetings: 8 conferences held abroad and 9 national and international forums held in Bulgaria. He acted as **Head of the Organizing Committee of the International Conference on DNA Barcoding and Biodiversity (ICDBB 2022)** held in the period May 25-27, 2022 in Sofia within the frame of BULCode.

Dr. Bonchev has been actively involved in a number of training activities that have contributed to the development of his professional competence in the chosen field. This aspect is clearly outlined in the presented track record among which are several educational courses: "**DNA barcoding - from sequences to species**", organized by the Norwegian University of Science and Technology; IAEA Regional Training **Course PCR Based Molecular Marker Systems**, Katowice, Poland; European Networking Summer School "**Plant Epigenetics**" IPK Gatersleben, Gatersleben, Germany; course 7th **BioSapiens European School in Bioinformatics**, Basel, Switzerland, etc.

### *3. Published research papers participating in the competition for the academic position of "Associate Professor"*

Dr. Bonchev participates in the competition with **16** publications (including 3 review papers). The candidate is listed as the **first or corresponding author in 11** of them suggesting **professional maturity** and ability to perform **independent research** in the chosen scientific field. The applicant's contributions to the experimental work performed can be clearly distinguished in most of the papers (except G7\_9 for which the details are not sufficiently provided). The published results follow chronologically the candidate's professional path. The papers have been co-authored with Bulgarian and foreign scientists with whom the candidate has collaborated in a number of scientific projects. Part of the manuscripts are published in **high-ranked journals** such as *New Phytologist* (Wiley), *Molecular Ecology Resources* (Wiley), *Environmental Science and Pollution Research* (Springer), and *Frontiers in Plant Science* (Frontiers Media), evidencing the high quality of the results. The total JCR IF of all publications for the competition is **55.553**. The JCR IF of the papers in which the Dr. Bonchev is listed as the first or corresponding author is **33.242**.

### *4. Evaluation of the scientific achievements*

The candidate's research is focused on **plant genome structural dynamics under normal and stressful conditions**. A substantial part of his research is devoted to the development of **DNA markers for genotyping and assessment of genetic diversity** in wild plants and agricultural crops. In the last few years, he initiated another line of research in the field of **DNA barcoding**, being one of the few Bulgarian scientists working on the topic. Based on these, it could be concluded that the research interests of the candidate are **in line with profile requirements of the announced competition for "Associate Professor" in "Genetics"** at the "Genome Dynamics and Stability" Lab of IPPG-BAS.

Dr. Bonchev has comprehensively summarized his main scientific achievements on 8 pages. The research performed by the candidate are related to **two main topics**, namely: "Development of DNA markers for genotyping and assessment of natural and mutant genetic diversity in plants" and "Genome selection in cereals".

#### **4.1. Development of DNA markers for genotyping and assessment of natural and mutant genetic diversity in plants.**

Most of the original scientific contributions of the candidate are related to this line of research. There are two major well-defined subcategories that reflect Dr. Bonchev's experimental work on the topic, namely "Mobile genetic elements, structural dynamics, development and application of transposon-based marker methods" and "Taxonomic studies by applying DNA Barcoding marker methodology".

##### *4.1.1. Mobile genetic elements, structural dynamics, development and application of transposon-based marker methods (publications **B4-5, G7\_5-11**).*

The major research achievements of Dr. Bonchev are in the field of mobile genetic elements (MGEs) known also as transposones. In his work, he applies methods based primarily on retrotransposons (class I MGEs). Retrotransposon-based methods are widely used for analysis in population and evolutionary genetics. They are regarded as an important phenomenon for the evolution of genomes by facilitating the translocation of genomic sequences. Transposons can also alter gene regulatory regions and participate in the rearrangement of exons. The clearly defined professional affinity of the candidate to this scientific approach is well evident and he applies it successfully for analyses of polymorphisms in different plant species at various experimental contexts. The retrotransposon-based marker system **REMAP** (REtrotransposon-Microsatellite Amplified Polymorphism), a type of genetic profiling based on amplification of the regions between the BARE-1 retrotransposon and its adjacent microsatellite DNA repeats, is part of the candidate's research toolkit. Dr. Bonchev and his colleagues from Comenius University have applied this method to evaluate phylogenetic links and genetic dynamics accompanying the processes of barley domestication (**B4\_4**). They have observed a substantial level of genetic polymorphisms among- and within-species showing that BARE-1 retrotransposon family has been a target for genome dynamics during the evolution and domestication of barley.

Within this collaboration, Dr. Bonchev has published interesting results also on genetic divergence and evolution in the genus *Hordeum*, applying for the first time the transposon-based marker method **iPBS** (inter-Priming Binding Site) in plants. As a result, a more detailed characterization of the genetic structure of *Hordeum agriocrithon* species was achieved, delineating its hybrid origin (**B4\_3**). The obtained results have linked *H. Spontaneum* accessions as ancestors of the *H. Agriocrithon* subgroup *paradoxon* suggesting the Caspian Sea region is the likely place of initial cultivation and domestication of the six-rowed barley.

Dr. Bonchev has applied iPBS to evaluate the genomic integrity in sunflower plants that have been subjected to treatment with neonicotinoids (**G7\_5**). The **iPBS** profiling visualized a divergent polymorphisms between the pesticide-exposed individuals and the control plants.

"**Transposon Display**", another method from the same category of marker systems, has been applied in a study published in *New Phytologist* (**G7\_6**) which describes important aspects of retrotransposons' dynamics in different *Arabidopsis lyrata* populations from North America.

The performed analyses included several models of evolution that make specific predictions about differences in the abundance of transposable elements between selfing and outcrossing taxa, and between small and large populations. One of the interesting observations made during this study was that despite the overall neutral behavior of TE elements they still hold the potential to disturb meiosis in a heterozygous state. This marker technique identifies the site of transposon integration and it can be used in functional genetics studies.

Case studies describing the application of transposon-based markers for genotyping of maize (**G7\_7**) and genetic variation and intergeneric hybrid dynamics among *Asteraceae* species (*Helianthus spp.*, *Echinaceae spp.*, *Tagetes spp.* and *Verbesina spp.*) (**B4\_2**) are included in the list of publications for the competition. The experimental approaches for the analyses of retrotransposon-related genetic distances in these studies use **REMAP** and **iPBS** techniques respectively.

There is also one research paper describing the candidate's work with class II MGEs (DNA transposons) (**B4\_5**). It investigates **genomic diversity and methylation patterns** of autonomous **Ac-like transposons** in EMS-generated *sphaerococcum* mutant lines of hexaploid wheat and triticale. The results clearly demonstrate the transposon-activating potential of this widely used mutagen chemical.

#### 4.1.2. Taxonomic studies by applying DNA barcoding system

In this subcategory, the applicant presents four publications that describe the implementation of DNA barcoding system for taxonomic identification of plants and phytopathogenic fungi.

##### 4.1.2.1. Taxonomic identification and evaluation of genetic biodiversity in plants (**B4\_1, G7\_2, G7\_4**)

Most of the published results in this subgroup are on experiments performed with medicinal plants (genera *Thymus*, *Nepeta* and *Sideritis*). The studies contribute to the otherwise scarce data on the genetic diversity of the endemic species from these plant groups. Taxonomic analyses (**B4\_1**) and determination of inter- and intra-species genetic diversity (**G7\_2, G7\_4**) are based on profiling of chloroplast DNA barcode regions. The PCR amplification patterns of the large Rubisco subunit (*rbcL*), the *trnH-psbA* intergenic region (a highly variable region of the angiosperm chloroplast genome) and the plastid gene for maturase K (*matK*) were the targeted DNA barcodes. Dr. Bonchev's contribution to the identification of *Sideritis elica* (Rhodope *elica*) as a new *Lamiaceae* species (**B4\_1**) should be acknowledged as this research result entered the news providing **public outreach visibility for the Institute of Plant Physiology and Genetics**. The discovery and description of this Bulgarian endemic species have a fundamental value for the more thorough characterization of biodiversity in this geographical region. This is a necessary prerequisite for the consistent steps for the conservation and rational use of rare and valuable species of the Bulgarian flora. The publication has been designated as **IPPG Scientific Achievement of 2022**.

##### 4.1.2.2. Taxonomic identification of phytopathogenic fungi in *Solanaceae* crops

Dr. Bonchev has successfully applied DNA barcoding methodology for taxonomic identification of *Colletotrichum* fungi in crop plants (**G7\_1**) combining "PCR fingerprinting"

technique **ITS** ("Internal Transcribed Spacer") with profiling of "house-keeping" genes encoding structural proteins (actin, tubulin, and actin-binding protein EF-1a). The conducted research is of significant practical value as the analyzed species are among the most devastating plant pathogens affecting a number of plant hosts including *Solanaceous* crops. The obtained data resulting from the implementation of the combined experimental approach corroborate the conclusion that multilocus barcode analysis should be applied for accurate identification of the different types of pathogens in a group of fungal isolates.

#### 4.2. Genomic selection in cereals

The candidate presents also published results on genomic selection of cereal crops (**G7\_3**). This line of research uses molecular genetic markers to design novel breeding programs or to develop new models for genetic evaluation. The research paper describes the identification of powdery mildew resistance loci in tetraploid wheat. It is a result of the collaborative work of Dr. Bonchev and his colleagues from Comenius University. To achieve this, the team employed **DArTseq** ("Diversity Arrays Technology sequencing") genotyping and **QTL** ("Quantitative Trait Locus") analysis of mapping populations. Powdery mildew is one of the most severe plant diseases that affect also wheat crops. The identification of new sources of resistance and their implementation in breeding programs is still regarded as the most effective way to control the pathogen's deleterious consequences. Therefore the newly identified multigenic loci have a significant practical value and could be implemented in future selection protocols.

#### 5. Professional networking, mentoring, and organizational activities.

Dedication to establishing professional networks and research collaborations at the national and international level is convincingly supported by Dr. Bonchev's key role in the development and coordination of the **BULCode** project. In this regard, Dr. Bonchev has initiated coordination meetings between scientific organizations from Bulgaria towards the development of a **National Network on DNA Barcoding** (with pilot name **BulBOL**). The candidate has organized also a number of trainings and field trips within the framework of the BULCode project, which have involved members of the work team as well as young researchers who are interested in DNA barcoding. Some of these initiatives are: Biodiversity data management course (BioDATA): **Accelerating biodiversity research through DNA barcodes, collection and observation data** (Yundola, 2023); two workshops on "**Introduction to DNA Barcoding**" and two training seminars - "**Green School**" and kickoff meeting of the BULCode project team.

The **contribution to the organization** of the **International Conference on DNA Barcoding and Biodiversity** (ICDBB 2022) held in the period May 25-27, 2022 in Sofia deserves special emphasis. The event undoubtedly increased the international visibility of IPPG-BAS in the field of DNA barcoding, providing opportunities for knowledge exchange, the establishment of new professional contacts, and future collaborations in the field.

The candidate is actively involved in research projects with several other IPPG Labs ("Experimental algology", "Regulators of plant growth and development", and "Regulation of Gene Expression"). In this collaborative work, he participates with expertise in the application of DNA markers including DNA barcoding for taxonomic study of microalgae, medicinal plants, and rare endangered species.

The candidate has articulated very well the future perspectives to expand his professional network and to attract young scientists who will be actively involved in the research process.

Dr. Bonchev has been a mentor to students from Sofia University "St. Kliment Ohridski" the Faculty of Biology, and from the New Bulgarian University within the program "Student Internships" of the Operational Program "Development of Human Resources" coordinated by the Ministry of Education and Science. The topic of the training program is "DNA molecular markers in plants" and it has been accommodated in 240 hours timeframe.

He has taught a practical course on "Functional genetics – genomics" for two semesters, included in the curriculum of "Genetics" and "Genetic and cellular engineering" Master's Degree Programs of the Faculty of Biology, Sofia University "St. Kliment Ohridski" (75 hours for 2008-2009; 90 hours for 2009-2010).

### **7. Recommendations**

The well-arranged presentation of the materials for participation in the current competition is highly appreciated as this significantly facilitates their assessment.

Dr. Bonchev's professional expertise in the field of MGEs and their application in a number of marker techniques for genotyping and analyses of polymorphisms are well-defined. This puts him in a very good position to expand his research work on the role of transposons in the regulation of gene expression which I would like to recommend. It has been demonstrated that MGEs participate in "gene silencing", as well as in the RNA alternative splicing. Transposons are also a major element of the epigenetic phenomenon of "imprinting. Research projects focused on such topics could increase the possibilities for productive collaborations in the field of functional plant genomics.

### **8. Conclusion**

As a specialist in DNA molecular markers and head of the laboratory of "Genome Dynamics and Stability" Dr. Bonchev works towards improving the expertise in this field of research through active collaborations with competent national and international teams seeking optimization of the DNA marker technologies for application in various biological objects – plants, fungi, algae. His ambition to attract young scientists to do research on the topic will increase the IPPG scientific capacity in DNA-based genetic research. This will promote the potential of DNA marker techniques for practical implementations such as the provision of expertise in the field of environmental studies, analysis of mixed samples from various biological objects, etc.

Based on the thorough review of the materials submitted for the competition, the project activities and scientific achievements, and taking into account his proactive role in the development and promotion of research in the field of DNA barcoding, which is sparsely represented at the national level, I address the respected members of the Scientific Jury and the Scientific Council of IPPG-BAS and **recommend awarding Dr. Georgi Nikolaev Bonchev** from the "Genome Dynamics and Stability" Lab of IPPG-BAS with the **academic position of "Associate Professor" in "Genetics"**.

28. 06. 2023

Reviewer:

Sofia

(Assoc. Prof. Irina I. Vaseva)