OPINION

by competition for the occupation of the academic position " **Associate professor** " in professional field 4.3. Biological Sciences, specialty Biochemistry, announced in SG No. 62/23.07.2024 for the needs of the "Photosynthesis - Activity and Regulation" laboratory of the Institute of Plant Physiology and Genetics - BAS, with a candidate **Chief Assistant Professor Gergana Mihailova, Ph.D**

**Reviewer:** Desislava Aleksandrova Todorova, PhD, **Associate professor** in the "Regulators of plant growth and development" laboratory, IPPG-BAS

Dr. Gergana Kirilova Mihailova is the only candidate for the announced competition. The presented materials in terms of form and content meet the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria and the Regulations on the Terms and Conditions for the Acquisition of Scientific Degrees and Occupancy of Academic Positions at IPPG-BAS.

**1. General data on the candidate's career and thematic development**

The candidate for the academic position "Associate professor" Gergana Kirilova Mihailova was born in 1982 in the city of Sofia. In 2006, he obtained a master's degree in "Biochemistry" at the Faculty of Biology of Sofia University "St. Kliment Ohridski". In the same year, she was enrolled as a full-time PhD student at the Institute of Plant Physiology "Acad. M. Popov" - BAS, currently Institute of Plant Physiology and Genetics - BAS. After a successful defense in 2012 of a dissertation on the topic: "Desiccation of the resurrecting plant *Haberlea rhodopensis* in conditions of high temperature and different light regimes" under the supervision of Prof. Dr. Katya Georgieva, Gergana Mihailova obtained the educational and scientific degree "Doctor" in "Biochemistry". In 2009, she was appointed to the position junior researcher III degree in IPP "Acad. M. Popov", and after the structural transformations of the scientific units at BAS, she successively held the position of assistant (2010-2014) and chief assistant professor (2014-present) at IPPG-BAS.

Dr. Mihailova's scientific interests are a natural continuation of the topic of her dissertation and are mainly focused on the study of the physiological and biochemical response of the photosynthetic apparatus of the resurrecting plants of the genus *Haberlea* to adverse environmental conditions such as drought in conditions of high light intensity or under the action of low temperatures. The majority of the articles (37 out of 43 issues) from her entire scientific career are related to the mentioned subject. Of these, 4 publications were used in the defense of the doctoral dissertation, and 19 experimental articles and 1 review were submitted for participation in the competition. In her career development, Ch. assistant professor Mihailova has been a participant in 23 national, international or bilateral scientific or educational projects, and has completed a total of 18 short-term specializations in scientific institutes and universities in Hungary, Germany, Spain and Italy. Ch. assistant professor Mihailova is a member of USB, section "Physiology and Biochemistry of Plants" and of the Federation of European Societies of Plant Biology (FESPB).

**2. Evaluation of the submitted reference for the minimum and specific requirements of the competition**

For participation in the current competition, 19 scientific articles and 1 review (book chapter) are submitted, which do not repeat those indicated for the acquisition of the PhD. According to the reference submitted by the candidate for the fulfillment of the minimum national requirements and the specific conditions of the Regulations of the IPPG-BAS for occupying the academic position "Associate professor", it is clear that G. Mihailova collects the required minimum points in all groups of indicators. In **group of indicators B**, she collects **100 points** (out of the minimum required 100 points) from 4 publications,

equivalent to habilitation thesis, all in quartile Q1. The total **IF** of these publications is **10.657**. In **group G**, assistant professor Mihailova collects **280 points**. In this group, she includes 15 experimental publications (265 points) and 1 review (15 points). The distribution of articles by quartiles is as follows: Q1 – 8; Q2 – 2; Q3 – 1 and one with SJR rank. The total **IF** of publications in group C is **33.295.** To the article with quartile falling into this group, Ch. Assistant Professor Mihailova also added 3 publications, which do not count, but complement the presentation of the candidate's scientific contributions, which I completely admire. Dr. Mihailova is the first and/or corresponding author in 7 of the publications and collects a total of **140** points with a requirement for a minimum of 110 points, according to Appendix 1 of the Regulations of IPPG-BAS on the specific conditions for occupying the academic positions, which shows that she has achieved the necessary professional development for leadership and in-depth research work in her chosen scientific area. The citations in scientific publications (**group D**), referenced and indexed in the world databases with scientific information are 237, and those that the candidate presents for participation in the competition are in **32 publications with a total of 196 references, forming 392 points**. The Hirsch index of Dr. Mihailova is 8 This shows that her scientific work has received a wide impact in the world scientific community. According to Appendix 1 of the Regulations of the IPPG-BAS on the specific conditions for occupying the academic positions, candidates for the academic position "associate professor" should collect a minimum of 70 points from participation and/or management of a scientific or educational project. According to **group E** indicators, in the reference, Dr. Mihailova indicates **120 points** from participation in 9 projects, of which 6 are national and 3 with international funding. And according to this indicator, her poits cover and significantly exceed the requirements.

The analysis of the scientometric data shows that the points with which Dr. Mihailova presented herself in the competition cover and significantly exceed the requirements for occupying the academic position "Associate professor" at IPPG-BAS. **With a required minimum of 540 points for an "Associate professor", Dr. Gergana Mihailova presented herself in the competition with 942 points**.

**3. Analysis of the main research topics in the candidate's research work**

The main contributions of Dr. Mihailova's scientific activity are summarized in 10 pages, providing systematized information about the experimental work performed, and she clearly defines her active participation in all publications presented for the competition. Ch. Assistant Professor Mihailova has no publications in which she is the sole author. All of them are collective with the participation of colleagues, both from IPPG and scientists from other scientific units in Bulgaria and abroad. This is understandable, since her research is part of scientific projects and developments carried out by the teams in them. According to the presented reference, the publications with which Dr. Mihailova appears in the competition can be conditionally divided into 2 thematic scientific areas:

1. Desiccation of the resurrection plant *Haberlea rhodopensis* in conditions of high light intensity, including 2 sub-areas:

1.1. Photosynthetic and biochemical characteristics of *Haberlea rhodopensis* plants growing under different light regimes in their natural habitats - publications No. B4-01, G7-01, G7-02, G7-03, G7-06.

1.2. Comparison of defense mechanisms during drought of sun and shade plants *Haberlea rhodopensis*, from one habitat - Publications No. B4-02, B4-03, B4-04, G7-04, G7-05, G7-07, G7-08, G7-09, G7-10, G7-14.

2. Cold resistance of the resurrection plant *Haberlea rhodopensis*. Photosynthetic and biochemical mechanisms of plant adaptation to low positive and negative temperatures. Comparison of the response

of emergent plants of the genus *Haberlea* and the genus *Ramonda*, family *Gesneriaceae*, to low temperatures - Publications No. G7-11, G7-12, G7-13, G7-15.

I fully agree with the candidate's reference of scientific contributions, and I accept it. The main contributions in the **first sub-area** are related to the differences established for the first time in photochemical activity, $CO_2$ assimilation, and in the amount of some stress markers, as they depend on the light intensity under which the plants grow. These differences form defense strategies for plant survival during drought, specific to those growing in sunny and shady habitats, respectively. The results presented in the **second sub-area** unequivocally show that the "sunny" and "shaded" plants of the genus *Haberlea* are characterized by different phenotype, morphological and structural changes in the leaves and cells, allowing to overcome the drought period more easily. "Sunny" plants are characterized by a higher photosynthetic activity and a higher chlorophyll content, and drought causes a stronger inhibition of photosynthesis in them, compared to "shaded" plants. In parallel, changes in non-photochemical reactions were also observed, showing for the first time that the two ecotypes use different strategies to quench excess light energy during drought. "Shade" plants dissipate the excess excitation energy from the photoinactivated PS2 reaction centers, while in "sun" plants the thermal dissipation of the excess excitation energy is carried out mainly by the antenna complexes. In "shaded" plants, more sugars accumulate in the cells, non-enzymatic antioxidants (ascorbate, glutathione, flavonoids) play a leading role in the scavenge of ROS and the xanthophyll cycle is more active compared to "sunny" plants, where, however, a dominance of antioxidant protection is provided by enzymatic antioxidants. "Shade" plants are characterized by a faster accumulation of the stress-induced proteins dehydrins and sHSPs during dehydration, but they accumulate in greater quantity in "sun" plants, which also correlates with higher gene expression, including that of an annotated novel drought-inducible gene ELIP. The new scientific facts obtained prove that the accumulation of protective substances in chloroplasts, increased thermal dissipation of excitation energy, including high activity of the xanthophyll cycle, reduced rate of photosynthesis, changes in pigment-protein complexes and photosynthetic proteins, shrinkage and curling of leaves, the accumulation of sugars, antioxidants and stress-induced proteins are the main mechanisms that have a protective role in the desiccation process of the "sunny" and "shaded" *H. rhodopensis* plants.

The **second area** refers to publications related to research on protective mechanisms in the process of acclimatization of *H. rhodopensis* to low positive temperatures, and as a result of the action of low negative temperatures. It has been shown that acclimation at low positive temperatures is accompanied by changes in the amount of photosynthetic proteins of the core complex of PS2 (D1, D2, CP43), the oxygen-releasing complex (PsbQ) and the Calvin cycle, the content of proline, hexoses and related with their metabolism enzymes. It was found that exposure to low negative temperatures leads to significant anatomical and morphological changes in the leaves, in the shape and structure of the chloroplasts, and is accompanied by biochemical changes in the amount of sugars, pigment-protein complexes, in the stoichiometry of LHC proteins, as well and in stress-inducible proteins such as ELIPs and dehydrins. The latest analyzes are pioneering and personal work of Ch. Assistant Professor Mihailova.

I believe that the submitted publications for the competition represent in-depth research that contribute the specific scientific profile of Dr. Mihailova as a perspective researcher in the field of molecular physiological and biochemical mechanisms of resistance against drought and low temperatures in resurrection plants of the genus *Haberlea*.

According to the reference, she has filed in the set of documents, the results of her scientific work have been presented in a total of 46 poster and oral presentations at 32 international and national scientific forums, including receiving the Third Prize for poster presentation at the International Conference 'Responses of Plants to Environmental Stresses', PISA-08, May 12 - 18, 2008, Elena, Bulgaria, which is an excellent attestation for the quality of her work.

**4. Analysis of the scientific topic and significance for science and society.**

I believe that the scientific interests of Ch. Assistant Prof. Dr. G. Mihailova are focused on a very current and significant field for the science. Given in mind the deepening climate changes, the candidate's research related to elucidating the biochemical and molecular mechanisms of drought resistance and cold resistance in resurrection plants is important for expanding scientific information on these problems. In a more distant perspective, this kind of research would be useful in developing strategies to increase the drought and cold resistance of economically important crops by using molecular and genetic approaches. The submitted list of 24 reviews of scientific publications and a total of 22 reviews of applications for grants and awards issued by FESPB, proves that she is an internationally recognized scientist in her scientific field and is sought after for expert opinion on the quality of other colleagues' research in related scientific fields.

**5. Organizational and training activities**

Dr. Mihailova has significant experience in educational activities, gained by supervising 4 students to develop student internships and a successfully defended diploma thesis - all related to the scientific topic she developed, according to the presented reference. She also conducted two training seminars on the molecular mechanisms of response of *Haberlea* plants to drought. She also performs administrative activities, being the secretary of the "Photosynthesis" laboratory in the period 2012-2017, and at the moment she is the secretary of the Section "Physiology and Biochemistry of Plants" at the USB (since 2013) and of the Assembly of Scientists of the IPPG -BAS (from 2022), which shows its excellent organizational and administrative qualities.

**6. Critical remarks and recommendations**

I have no critical remarks about Ch. Assistant Professor Mihailova. I recommend a higher activity of the candidate in the publication of the scientific results, such as taking a greater commitment in the key function "corresponding author", which is inherent in the relevant academic position, and also in her capacity as a leader/coordinator of a team in development and implementation of scientific projects. I also recommend that she use her scientific expertise to supervise PhD students in the development of a dissertation thesis. The recommendations made do not belittle the candidate's contributions to the development of the scientific topic, but will be useful in her future work as a qualified scientist.

**7. Conclusion**

After the analysis of the scientific activity of Ch. Assistant Professor Gergana Mihailova, I express my positive opinion that the candidate fully meets the profile of the announced competition. She participates with scientific publications sufficient in terms of volume and quality, and the points she collects from scientific activity significantly exceed the legal requirements and the Regulations for the specific conditions and procedure for occupying the academic position "Associate professor" at IPPG-BAS. The candidate has a clear scientific profile in a scientific field relevant to the physiology and biochemistry of plants and important for society. In addition to high scientific value, her research has the potential to be further developed in the future, which is thoroughly argued in her vision for professional development after habilitation. **All this gives me reason to confidently recommend to the respected members of the Scientific Jury and the Scientific Council at IPPG-BAS to award the academic position "Associate professor" to Ch. Assistant Professor Dr. Gergana Mihailova** in professional direction 4.3. Biological Sciences, specialty Biochemistry.

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Sofia /Assoc. Prof. Dr. Desislava Todorova/