

REPORT

on the materials submitted for a competition for the academic position of "Associate professor" in the field of higher education 4. "Natural Sciences, Mathematics and Informatics", professional field 4.3 "Biological Sciences", scientific specialty "Plant Physiology", for the needs of the laboratory "Regulators of plant growth and development", Institute of Plant Physiology and Genetics - BAS, announced in SG No. 22/15.03.2024

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One candidate participated in the competition announced by the Institute of Plant Physiology and Genetics - BAS (SG No. 22/15.03.2024) for the academic position of "Associate Professor" for the needs of the laboratory "Regulators of Plant Growth and Development" - Assistant Professor Dr. Zornitsa Ivanova Katerova-Landzhova. In order to participate in the competition, all the required documents that meet the requirements of LDASRB and the Regulations on the terms and conditions for acquiring scientific degrees and occupying academic positions at IFRG - BAS have been submitted.

Professional and thematic development of the candidate

Assistant professor Dr. Zornitsa Katerova-Landzhova graduated from the Faculty of Biology of the Sofia University "St. Kl. Ohridski" with a master's degree in "Biotechnological processes", specialization "Industrial biotechnologies". From 2002 to 2008, she was a doctoral student at IFRG and after defending her PhD thesis on "Physiological-biochemical changes in pea plants irradiated with UV-B and UV-C" in 2009, she obtained the educational and scientific degree "doctor" in scientific specialty "Plant Physiology" (code 01.06.16). For her dissertation work, she was awarded a diploma from USB and HAC in a competition of doctoral students who defended in 2008. Since 2010, she has been an Assistant professor in the same scientific specialty at the Institute of Plant Physiology and Genetics. Undoubtedly, several specializations in renowned laboratories abroad contributed to her professional growth in the field of plant physiology. As a doctoral student, she specialized for 5 months in the Laboratory of Plant Physiology and Biochemistry at the Faculty of Biology of the University of Antwerp, Antwerp, Belgium. Dr. Katerova-Landzhova trained for 36 months at the National Agriculture and Food Research Organization in Sapporo and in Tsukuba, Japan on a Japan Society for Promotion of Science (JSPS) postdoctoral fellowship.

During the entire period of her professional development, the scientific activity of Dr. Katerova-Landzhova is in the field of plant physiology of economically important crops with

emphasis on the influence of various abiotic factors from the environment and the possibilities of limiting their effects on the development and productivity of plants. This topic is related to the scientific direction of research in the "Regulators of plant growth and development" laboratory of the IFRG. Dr. Katerova-Landzhova has co-authored 43 scientific publications in a number of renowned scientific journals presenting results of her research. A number of experimental results have been presented at international and national scientific forums as posters and reports.

Scientific data

The detailed report presented by Assistant Professor Katerova-Landzhova on the implementation of the minimum national requirements for holding the academic position "Associate professor" correctly reflects her scientific output and shows that these requirements are not only met, but also exceeded.

Dr. Katerova-Landzhova participated in the competition with 21 scientific papers, of which 18 were articles in scientific journals with an impact factor (total impact factor 22.225, and the impact factor of the articles in which Dr. Katerova-Landzhova is the first or corresponding author is 14.78) and three are book chapters. The distribution of articles according to the quartiles of the journals in which the articles were published is as follows: 3 in Q1, 7 in Q2, 7 in Q3 and one in Q4. In twelve of the reports, Dr. Katerova-Landzhova is the first or corresponding author, which reflects her role in the conducted research, analysis and proposed hypotheses. A significant part of the publications (7), with which Assistant professor Dr. Katerova-Landzhova has participated in the competition have been published in the last 5 years. To participate in the competition, the candidate submitted a list of 173 independent citations (excluding self-citations of all authors). After excluding the self-citations of all authors, the h-index of Dr. Katerova-Landzhova is 10 (Scopus). These scientometric data determine Dr. Katerova-Landzhova as a scientist with active research activity.

The submitted report on the fulfilment of the national minimum requirements by the LDASRB and the Regulations for the specific conditions and procedure for occupying the academic position "Associate professor" at IFRG-BAS shows that the total number of points from the scientometric indicators with which Dr. Katerova-Landzhova participated in the competition is 836, which fulfils and exceeds the required minimum of 540 p.

The distribution of points by indicators is as follows:

In group A (dissertation work for the award of ESD "doctor") - 50 points.

In group B.4, 6 articles are included, of which 4 are in journals in quartile Q2 and 2 in Q3, and the total number of points according to group B indicators is 110 points (the requirement is for a minimum of 100 points). The total impact factor of the articles in indicator B.4 is 3.583, with Dr. Katerova-Landzhova being the first or corresponding author in 2 of the publications, which correspond to 35 points.

15 publications are included in indicator group G, distributed as follows: G7 -12 scientific publications as 3 are in Q1, 3 in Q2, 5 in Q3 and one in Q4, with a total impact factor of 18.642 and correspond to 215 points. The total impact factor of the articles is 18,642, and of those in which Assistant Professor Katerova-Landzhova is the first or corresponding author is 13,684. According to indicator G8, 3 book chapters are presented, which form 45 points, and thus the total number of points according to indicator G is 260, with a required minimum of 200 points. The points that Dr. Katerova-Landzhova collects from the articles in which she is the first or corresponding author under indicator G are 185, which fulfils the condition of the Regulations for the Application of LDASRB in IFRG that at least half of the points under indicator G must be composed by publications in which the applicant is listed as first or corresponding author.

In group D (citations), the candidate submitted a list of 173 independent citations or 346 points with a requirement for a minimum of 200 points.

According to indicators in group E, Dr. Katerova-Landzhova presents data on indicators E.14 and E.15 - participation in scientific and educational projects. She participated in one educational project under the "Human Resources Development" program, and as a member of a work team participated in two youth and two research projects funded by the National Institute of Scientific Research - 50 points. According to indicator E.15, participation in one international project was noted (20 points), thus collecting the required number - 70 points for group E.

Main directions in the scientific research work and scientific contributions of the candidate

In her scientific activity, Dr. Katerov-Landzhova focuses on the influence of abiotic factors from the environment, including UV radiation, drought, waterlogging, herbicides on the physiological characteristics of plants, mainly economically important crops being studied. These studies are coupled with exploring the possibilities of using a number of growth regulators to minimize the harmful effects. Changes in the Earth's climate, the presence of an ozone hole in the atmosphere, soil and air pollution and their impact on

agricultural crops largely define the subject of Dr. Katerova-Landzhova's scientific research as current and timely.

The first and most extensive direction in the research activity of Dr. Katerova-Landzhova, presented in 11 of the presented scientific works is dedicated to

1. Study of the physiological effect of ultraviolet radiation (UVB and UV-C) in important cultural plants and possibilities to overcome the negative effects by applying growth regulators.

Research on the effects of UV radiation is a logical continuation of the candidate's dissertation work.

The first sub direction is defined as

1.1. Physiological effect of ultraviolet radiation (UV-B and UV-C).

Ultraviolet radiation, and especially the shorter-wavelength UV-B and UV-C (UV-C has the highest energy) directly and indirectly affects a number of important processes and components in plant cells. The articles presented for the competition examine and compare the effect of UV-B and UV-C on a number of physiological and biochemical parameters of the studied plants. The response of several plants was analysed - monocot triticale (B4-1, B4-3), barley (B4-2) and wheat (B4-2, G7-2, G7-3) and dicot pea (B4-2, B4-5, B4-6, G7-1, G7-4) and tomatoes (B4-4).

In the report on scientific contributions, Dr. Katerova-Landzhova correctly presents her own contribution to the conducted research and obtained results, emphasizing the contributions from the scientific publications in which she is the first or corresponding author.

The contributions of the publications presented in group B are based on the establishment and comparison of the effects of UV-B and UV-C irradiation on several types of plants - triticale, wheat, peas, and tomatoes.

With the application of the treatment for different periods of time - once (B4-2, B4-4, B4-5, D7-3, G7-4), from 4-5 days (B4-1, B4-3, G7-2) or 21 consecutive days (B4-6, G7-1) new and confirmatory scientific data have been established regarding the effect of UV-B and UV-C on wheat, triticale, barley. As an innovative approach, I would note the application for a longer period of daily irradiation of plants with lower intensity UV-C (B4-6, G7-1), which turns out to be suitable for tracking the dynamics of the activation of the defence mechanisms of pea plants (*Pisum sativum* L.). It should be noted that while research on the impact of UV-B is very intensive and widely reported in the literature, that on the impact of UV-C is comparatively more modestly presented and Dr. Katerova-Landzhova's research adds new information and data.

When pea plants were treated with low doses of UV-C, a slight increase in the levels of hydrogen peroxide (an indicator of its signalling role) was found, accompanied by a decreased content of malondialdehyde, suggesting the possibility of activating defence mechanisms in pea plants protecting against lipid peroxidation and membrane damage in leaves of different ages - 7, 14 and 21 days (B4-6, G7-1). In the studies devoted to the influence of UV-C, the results obtained at high doses of UV-C irradiation of isolated nuclei from monocotyledonous and dicotyledonous plants (with different genome sizes) should be noted. The study applied the Trypan blue exclusion assay to plant nuclei for the first time and, using a neutral comet assay to identify DNA double-strand breaks, showed that plants with a larger genome size were more -tolerant to this treatment (B4-2).

In a chapter of a book, in which Dr. Katerova-Landzhova is the lead author, studies from a number of laboratories in the field of the influence of UV radiation on endogenous growth regulators and phytohormones and the synthesis of secondary metabolites are summarized and synthesized, and the possibilities for the use are discussed as an elicitor for the synthesis of growth regulators, phytohormones and secondary metabolites, which would be useful for application in medicinal plants (G8-1).

The above-mentioned studies are expanded and supplemented in the developments in the following sub-direction:

1.2. Possibilities to overcome the negative physiological effects of ultraviolet radiation (UV-B and UV-C) by exogenous application of growth regulators.

The publications from group B4 (1, 3, 4, 5) and G7 (2, 3 and 4) present the studies on the possible protective effect of exogenously applied growth regulators such as polyamines (spermine), the retardant MEIK (β -monomethyl ester of itaconic acid), the preparation Biomin, containing humic acids and the auxin-like compounds (TA-12 and TA-14), which could be applied to minimize the negative effects of UV radiation.

The pre-applied polyamine spermine has been shown to help maintain normal plant growth and reduce damage caused by high-dose UV-C irradiation of pea seedlings. A mechanism for this protection has been proposed, involving stabilization of cell membranes and activation of non-enzymatic antioxidants (B4-5).

Of interest are studies on the influence of UV-B irradiation on tomato plants - wild type *Aisla Creig* and the mutant *ah*, which does not synthesize anthocyanins, as well as the influence of pre-treatment of plants with MEIC. MEIC pre-treatment was found to reduce the negative effects of UV-B irradiation and the protective effect of MEIC was better expressed in the wild type containing anthocyanins (B4-4). The protective function of MEIC pre-

treatment was also shown against damage induced by UV-C irradiation in wheat plants as assessed by the levels of the stress markers MDA and proline (G7-2).

A protective effect has been established for the preparation Biomin in triticale. Root application of Biomin leads to an increase in antioxidants and UV-V absorbing compounds, improves growth, increases antioxidants (including anthocyanins) and stimulates peroxidase and superoxide dismutase activity, thus reducing damage from oxidative stress caused by irradiation with UV-B (B4-3).

Foliar pre-treatment with the auxin analogues 1-[2-chloroethoxycarbonyl-methyl]-4-naphthalenesulfonic acid dicalcium salt (TA-12) and with 1- [2-dimethyl methoxycarbonyl methyl]naphthalene chloromethylate (TA-14) was found to reduce UV-B-induced oxidative stress, analyzed on the basis of reduced MDA levels, increased content of thiols and UV-absorbing compounds, and had a positive effect on H₂O₂ content and the activity of superoxide dismutase, catalase and guaiacol peroxidase (G7-4).

The second main direction in the scientific activity of Assistant professor Katerova-Landzhova is in the field of the physiological response of economically important crops subjected to other stress factors, and research in this direction is conditionally divided into two sub-fields:

2.1. Physiological effect of abiotic stresses (drought, waterlogging, herbicides).

2.2. Possibilities to overcome the negative physiological effects of abiotic stresses (drought and herbicides) through exogenous application of growth regulators.

In the majority of the materials presented in this direction, Dr. Katerova-Landzhova is the lead or corresponding author, which unequivocally shows her significant contribution to these studies.

In the first sub-direction, materials related to the analysis of the physiological characteristics of wheat and triticale after pre-treatment with the herbicide Zerrate and subsequently subjected to drought or waterlogging are presented.

A wide range of phenotypic, biometric and biochemical analyses were carried out as elements of the first comprehensive study of the physiological response of wheat (variety Sadovo-1) and triticale (variety Rozhen) to the combined effect of the selective herbicide Zerrate (Syngenta) and water stress (G7-5 to G7-10). The study of these plants is appropriate because they show a comparative tolerance to this selective herbicide, which is confirmed by the results regarding the influence of Zerrate on the phenotype and antioxidant status of triticale (G7-7). Treatment with the herbicide Zerrate and drying leads to increased accumulation of reactive oxygen species (respectively more serious damage) and stimulates

the activity of antioxidant enzymes in triticale plants. It was found that in wheat, treatment with herbicide and subsequent drought for 7 days does not lead to additional damage and the plants retain their ability to recover relatively well after the inclusion of a normal watering regime (G7-6, G7-8). When triticale and wheat were compared in terms of Zerrate application and waterlogging, it was found that the response of the two plants was different: triticale showed a higher tolerance to waterlogging while more serious damage was observed in wheat and the plants did not recover, suggesting a synergistic effect of the two factors (G7-5). It should be noted that the publications related to the research on the herbicide Zerrate and the stress effects find a wide response, which shows the relevance of this topic.

In the research of Dr. Katerova-Landzhova, for the first time a different response of wheat and triticale with respect to the endogenous polyamines under stress effects and during recovery was reported. While in wheat, after an initial decrease, drought leads to an increase in endogenous levels of putrescine, spermine and spermidine, a decrease in polyamines was recorded in triticale after drying. It was found that in terms of waterlogging, the levels of polyamines in the two plants showed an opposite trend, with wheat decreasing and triticale polyamine pool increasing (G7-9, G7-10). The personal contribution of Assistant Professor Katerova-Landzhova in this sub-direction is accurately reflected and includes conducting the experiments, analysing the results, writing the publications (G7-5 to G7-10).

In direction 2.2, contributions related to research dedicated to the possibilities of overcoming the negative effects of drought and herbicides on physiological characteristics with the application of growth regulators are included. The relevance of these studies is based on the fact that these are ecologically sound approaches to deal with the effects of abiotic stress on plants. The possibilities of these methods are summarized in a book chapter (G-8) which shows that exogenous application of polyamines and brassinosteroids can be successfully applied to minimize the negative effect of drought on plants. Dr. Katerova-Landzhova's contribution is in the analysis and summary of the impact of exogenous application of brassinosteroids in the response of plants to drought. Experimentally, the question of the effect of brassinosteroids in the response of wheat to herbicide glyphosate is addressed in paper G7-12, showing that pre-treatment with 24-epibrassinoid partially restores the herbicide-induced reduction in shoots growth and has the potential to reduce oxidative stress.

What has been presented so far clearly shows that Dr. Katerova-Landzhova has a defined scientific topic that is relevant both for enriching our knowledge about the response of plants to abiotic stress, but also has practical and socially significant dimensions.

Expert and organizational activity of the candidate

Dr. Katerova-Landzhova was a reviewer of 25 articles for scientific journals, participated as a technical editor in the editorial board of a journal published by the IFRG. She participated in a commission for the development of Regulations for the implementation of the LDASRB in the IFRG.

Prospects for future research.

The outlined directions for future research of Dr. Katerova-Landzhova are a logical continuation of previous scientific work, updated with the latest achievements of science, emphasizing their potential for practical application.

I would recommend the candidate to activate her activities in the future in the training and mentoring of masters and doctoral students.

Conclusion

The presented materials convincingly show that Dr. Katerova-Landzhova is a scientist working in an up-to-date and significant direction of modern science. The topic of her research work is among the main directions in the goals and mission of IFRG. Most of her research is of an original nature and is a contribution to fundamental science, and many of them have serious potential for practical application. Dr. Katerova-Landzhova's academic performance fully covers and exceeds both the national and IFRG criteria for holding the academic position of "Associate Professor".

I positively assess the candidacy of Dr. Katerova-Landzhova for the academic position of "Associate professor" and I will vote YES. I recommend the members of the respected Scientific Jury to propose to the members of the IFRG Scientific Council to elect Dr. Katerova-Landzhova to the academic position of "Associate professor" in the professional field ".4.3. "Biological Sciences", scientific specialty "Plant Physiology".

June 21st, 2024

Sofia

Signature:

/Prof. Dr. M. Velitchkova/