



## REVIEW

regarding the competition for "professor" in the scientific specialty Scientific field 4. Natural sciences, mathematics and informatics, professional direction 4.4. Earth Sciences, scientific specialty "Ecology and Ecosystem Protection", announced in SG no. 62 of 21.07.2023 with Candidate Associate Professor Dr. Stefan Ivanov Shilev

by Prof. DSc Dr. Yana Ilieva Topalova, Sofia University "St. Kliment Ohridski" professional direction 4.3. Biological sciences, scientific specialty "Hydrobiology", designated according to Order No. RD -16-898/25.09.2023 of the Rector of the Agricultural University - Plovdiv as a member of the scientific jury

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

The only participant in the announced competition - Associate Professor Dr. Stefan Ivanov Shilev - is a teacher at the Department of Microbiology and Environmental Biotechnology of the Agricultural University - Plovdiv. He currently has almost 25 years of work experience, most of which was spent at the Agricultural University. From the mentioned work experience, it can be seen that Associate Professor Shilev consistently and systematically formed and grew simultaneously as an engineer-agronomist, but also as a researcher, partner and leader of teams for innovative and modern environmental research, public figure, organizer and active participant in various administrative bodies in the university, the municipality, the RISV, international organizations. In the course of these complex and active activities of his, he has gained valuable experience in the field of teaching, pedagogy, research, managerial and organizational work at AU-Plovdiv, as all his activities from a substantive point of view the candidate with the idea of environmental protection and application of innovative ecological biotechnologies and circular solutions, increasing the quality of soils, their restoration, increasing yields of agricultural crops, increasing the efficiency of resource use and turning waste into a valuable resource. In all this focus, I can highlight one more feature – the emphasis is on the study and application of the enormous potential of microbiological stimulation. I can responsibly state here that the entire professional path of Associate Professor Shilev is the path of a scientist and teacher with a vocation, talent and deep motivation to create excellently trained agroecological, microbiological and managerial personnel with modern ecological theoretical training and applied knowledge, skills, competences and qualification.

Associate Professor Shilev completed his master's degree as an agronomist engineer in 1996, specializing in plant protection. Worked consecutively as an assistant, defended a doctoral dissertation in the field of remediation of soils contaminated with heavy metals at the University of Córdoba - Spain - 2003, associate professor in the scientific specialty Ecology and Ecosystem Protection - 2010, graduated from various specializations in a row - in Environmental Biotechnology at BF -SU -1998, specialized in the University of Córdoba Spain, Specialization in phytoremediation in Trieste - Czech Republic, postdoc in 2007 - bacterial proteomics in UniCordoba, specializations and courses in waste management in Aachen Germany, etc. international courses and specializations - Sardinia Italy in bio- and phytoremediation techniques for the restoration of mining areas, a course in resource and waste management at Eur. Commission, was a lecturer in Varšar, Croatia. In 2010, he obtained his habilitation at the State Academy of Medical Sciences under the code 02.22.01 "Ecology and Ecosystem Protection" (Ecology of Microorganisms). Prof. Shilev holds a series of public positions. He speaks Spanish, English and Russian.

His research profile is well formed, clearly focused on soil restoration, resources, circular use of water, plant and other biomass, stimulation of phytoremediation and microbial remediation with modern environmental microbial technologies and biotechnologies to improve soil cleanliness, fertility and increase of the yields of valuable plant crops.



All this with a focus to solve complex and complex environmental and resource problems based on innovations in agrobiotechnology.

With key words, his professional competence can be characterized as competent in: circular bioeconomy, microbial technologies, utilization of waste biomass from agriculture, the food industry or the maintenance of parks and gardens, waste utilization processes /sediments, plant, etc./ through composting, obtaining a final product that is extremely necessary in agriculture, landscaping, to restore disturbed areas. Emphasis in his professional competence is stimulating the bioremediation processes of soils and, on this basis, increasing yields from agricultural crops. A second emphasis is the use of the enormous microbial potential of stimulated autochthonous and allochthonous specialized microbial cultures to improve soil and plant health.

## 2. General description of the presented materials.

In the competition for "professor" in the scientific specialty "Ecology and ecosystem protection", the candidate participated with a total output of 76 papers, grouped as follows:

- Publications related to the doctoral dissertation – 6 issues, which are not subject to consideration, for associate professor 35,
- Scientific publications on the nomenclature specialty in the competition for professor 26 items, of which with IF - 12 items. with a total IF of 31,679
- Publications in peer-reviewed and refereed scientific journals in world-renowned databases 20 issues;
- Journal publications with JRC – 14
- Publications in non-refereed journals or edited conference proceedings - 5 issues;
- Independent publications 3 nos., first place 14 nos.,
- Study guides – 1 item.
- Citations in Scopus – 633, H index -12
- To prepare the review, 25 scientific publications and 1 book chapter are subject to analysis.

This voluminous scientific production and high scientometric indicators are condensed from a content point of view high scientific, scientific technological and educational achievements in the most modern directions of ecological, agrobiotechnological and microbiological science and practice. In the specific case, the requirements for success in these areas require a high degree of interdisciplinarity, cross-disciplinarity, respect for the deep details and mechanisms of ecological processes, without losing sight of the big picture. All this is visible through the modern scientific, research and teaching activity of the candidate for PROFESSOR.

Here it is appropriate to emphasize that the documentation for the competition, apart from being in accordance with the requirements of the conditions under section IV of the ŽRASRB, resp. - of Art. Art. 60 and 61 of the PPZRAS and of the Recommendations for the given academic position in the rules of the AU, is diligently, comprehensibly, neatly formed with respect for details and accuracy of facts.

## 3. Main directions in the candidate's research work. Demonstrated skills or aptitude for leading scientific research (project management, attracted external funding, etc.).

The main directions in the research and from there it reflects in the educational and social. the public activities of the candidate for professorship are in the field of phytoremediation and microbial remediation of soils contaminated with heavy metals and use of beneficial microorganisms and soil improvers based on sludge compost, etc. organic waste to improve the growth and yields of agricultural crops. All this reflects on the technologies for utilization of biological waste and sludge, a detailed study, incl. and at the molecular level of the structure of native and modeled microbial communities.



Waste reuse and recovery is linked to waste management and climate issues. In this way outlined, environmental problems are contemporary, timely and are the basis of EU bioeconomy and circular economy strategies. All these problems in more detail or in a more general plan were developed by the professor candidate in the numerous international and national projects that Assoc. Prof. Stefan Shilev led and/or participated in them as a valuable partner. The candidate was the head of 11 projects, of which 6 were international. He participated in 13 projects with national and/or international funding, he is a member of national and international committees of scientific forums. With this activity, he attracted about BGN 667,300 for AU-Plovdiv. He worked together with famous national and international scientists, created a school of young researchers and followers who grew from bachelor to master and defended doctorates in the scientific specialty "Ecology and conservation of ecosystems".

#### **4. Evaluation of the pedagogical preparation and activity of the candidate. Its role in the training of young scientific personnel.**

The candidate's educational and training record is impressive. In addition to the huge horary of lectures and practical classes, which Assoc. Stefan Shilev has realized every year, he is a talented creator of modern educational products.

He is the co-author of the Guide to Microbiology, the author of 9 study programs for the bachelor's degree / discipline "Microbiology" (specialty "Hydromelioration", "Agronomy - field farming" and "Biological agriculture"), "Waste Management" (new discipline, speciality "Ecology and environmental protection") and "Utilization of agricultural waste" (new discipline, special "EEOS" and "Biological agriculture"). New elective subjects with corresponding curricula have also been developed. The discipline "Ecology of Microorganisms" was developed for the first time about 20 years ago and has been carried out in the Faculty of "Plant Protection and Agroecology" ("EOOS" and "Plant Protection") until now without interruption. Other developed curricula are for the optional disciplines "Biodegradation and bioremediation" and "Utilization of agricultural waste".

Associate Professor Shilev is the author of 6 study programs in the OKS Master - "Microbiology" (Master's course "Plant Protection" for students from DOVO), "Waste Management", "Municipal Environmental Programs" and "Circular Economy and Resource Utilization" (MK "Ecology of settlement systems", SOVO and DOVO), "Microbial communities of the components of the environment" (MK "Protection of biological diversity") and "Processing and recycling of biomass" (MK "Bioeconomy"). The disciplines "Environmental microbiology" and "General microbiology" are taught with foreign students under the Erasmus program according to the corresponding developed curricula.

Initiators, a leading participant in the development of a new direction at the Agricultural University - Plovdiv, which is "Waste Management". The discipline is extremely important for graduate environmental specialists, along with Solid Waste Treatment Technologies. With the introduction of the discipline, a gap in their training is filled, which is an essential advantage in their realization. He was the supervisor of 12 bachelor's theses and 6 master's theses. He has 2 defended doctoral students, 1 dismissed with the right of defense and one currently working - all in the scientific specialty "Ecology and ecosystem protection". These specialists are fresh additions to Assoc. Shilev's school.

I value teaching and teaching contributions as significant and equal in terms of future response in society to scientific and research contributions. Especially taking into account that every discovered scientific innovation in the field of ecology and ecosystem protection is directly implanted as educational content in the disciplines taught by Associate Professor Shilev. I have a long-term and personal impression of it.

#### **5. Significance of the obtained results, proven by citations, publications in prestigious journals, membership in international and national scientific bodies, etc.**



The results presented in the competition documentation are of high scientific, applied and educational value. The high citation rate, the high scientometric indicators indicated above are eloquent numerical indicators that Associate Professor Shilev is an established scientist on a national and international level in the scientific specialty "Ecology and ecosystem protection" and more specifically in the directions, again detailed below above. He is a member of national and international organizations in the field of ecology and biotechnology, holds important administrative positions in the AU - he worked as the chairman of the OS of the AU, a member of the FS, a member of the AU, a representative in the 47th and 48th National Assembly. His expert work is highly valued – he was a reviewer and guest editor of more than 70 scientific articles in national and international journals.

## 6. Significance of contributions for science and practice.

The candidate for professor, associate professor Shilev, has a clearly defined scientific research, applied profile with significant contributions in the field of phytoremediation of soils contaminated with heavy metals, with the participation of beneficial microorganisms, application of microbial communities to improve the growth and yields of agricultural crops, utilization of biowaste through composting, molecular study of soil and compost microbiome, climate change and environmental protection.

### A. ORIGINAL CONTRIBUTIONS

For the first time in Bulgaria, soil microbial communities were studied based on their metabolic profile during phytostabilization of soils contaminated with heavy metals (review publication in *Environmental Engineering and Management Journal*, Q3, IF=0.858). For the first time in Bulgaria, metagenomic analysis was applied to reveal the diversity of the compost microbiome. In the treatment of WWTP sludge by composting and vermicomposting (publications 5,17,19).

For the first time in AU-Plovdiv, the problems with bio-waste treatment were systematically and thoroughly investigated. The research has a direct application in the economy to solve problems of great public interest, such as the accumulation of biowaste. For the first time in Bulgaria, an analysis of the diversity of molds in thermophilic and mesophilic habitats during composting of WWTP sludge, cow manure and straw is provided. The communities of mesophilic molds were found to be characterized by greater diversity, while those of thermophiles had a higher overall activity. The genera *Psathyrella*, *Chaetomidium*, *Mortierella* and *Cheilymenia* represent 85% of mesophilic fungi, and *Mortierella* and *Thielavia* are 78% in thermophilic habitats. In this sense,  $\beta$ -glucosidase activity and  $\alpha$ -diversity values in molds are higher in mesophilic zones (publication 19).

### B. METHODOLOGICAL CONTRIBUTIONS

An adapted next-generation sequencing method has been applied to elucidate the processes occurring in composting and vermicomposting of biodegradable waste and sewage sludge has made a significant contribution (publications 18,19,20).

### C. SCIENTIFIC CONTRIBUTIONS

It has been found that concentrations above 10 g.l<sup>-1</sup> of mine tailings in soil application and 5 g.l<sup>-1</sup> in hydroponic application suppress the growth of sunflower and lead to an increased accumulation in the above-ground mass of the heavy metals presented (21), and that the population of the beneficial bacterium *Pseudomonas fluorescens* biotype F most strongly stimulated As accumulation in sunflower leaves, stems and roots when using higher concentrations (20 mg As l<sup>-1</sup>). This leads to a significant reduction in plant biomass (26). A population of *P. fluorescens* stimulated xylem sap movement in sunflower both in the absence and presence of arsenate (26). A regression mathematical model was derived to describe the role of the bacterial population of the isolate *P. fluorescens* biotype F, As concentration in the soil and accumulation of the metalloid in the aerial parts of sunflower. Part of the research was funded by the regional



government of Andalusia, Spain through the University of Córdoba, and others by AU-Plovdiv (26). In the bioremediation of soils, the microbial transformations of elements in the rhizosphere occupy an important place as a key moment of their cycle, which can be the basis for a wide range of innovative biotechnological processes. The team published the review in a journal in Q1 and IF=4.125. An independent review publication has been published on the ability of rhizobacteria to regulate the uptake of nutrients and potentially toxic elements by plants. It is part of a monograph realized with an international team of scientists to clarify the fundamental processes in the symbiotic interactions in the rhizosphere between plants and microorganisms (Publications 2,12).

*Saccharomyces cerevisiae* yeast strains tolerant to Cd and As have been characterized, with potential for application in phytoremediation processes. The tolerance of cells cultured in vitro in the presence of increasing concentrations of  $\text{Na}_2\text{HAsO}_4$  (0-1200 ppm) and  $\text{Cd}_2\text{Cl}$  (0-10 ppm) was found to be about 100 higher to arsenic than to cadmium (11,14). Tolerance to arsenic is due to the ability of cells to transport excess amounts out of the cell at a rate that depends on the concentration of the metalloid in the medium (14).

In the development of the application of beneficial microorganisms to increase the yield of agricultural crops, the ability of beneficial bacteria to mitigate abiotic stress in plants has been proven. A significant reduction of  $\text{Na}^+$  accumulation was found in all parts of sunflower plants at 100 mM NaCl in the medium and introduction of the bacterial populations of the isolate *P. fluorescens* biotype F or of *P. fluorescens* CECT 378. At the same time, the values of accumulated  $\text{K}^+$  were increase significantly. The results were presented at an international congress and published in a journal in Q1 and IF=8.91 (3). The ability of *Candida melibiosica* 2491 to produce the enzyme phytase, which has been characterized with the aim of subsequently enriching animal feed, improving phosphorus nutrition and reducing losses of this important non-renewable resource, has been investigated (13). Publications in Applied sciences, Q1, IF=2.7 and book chapters referenced in global databases review the latest advances in biotechnology regarding the role of beneficial microorganisms in soil and plant health, mitigating stress for plants resulting from increased salt concentrations and drought (6,8,16). characterized with the aim of subsequently enriching animal feed, improving phosphorus nutrition and reducing losses of this important non-renewable resource (13).

In the direction of "utilization of biowaste through composting" the possibility to stimulate bioremediation processes and to suppress soil phytopathogens by using compost in the context of modern agricultural policy has been established (1). Bio-waste processing in Europe is considered in the context of the current EU policy regarding the circular economy, recycling and recovery technologies that lead to high added value and jobs, lower ecological footprint /24/. Models have been prepared for the utilization of WWTP sludge in agriculture, landscaping activities and for the reclamation of disturbed areas. An approach has been established to reduce the concentration of heavy metals originating from the WWTP sludge during joint treatment, so as to obtain a final product that meets the requirements laid down in the Ordinance on the separate collection of biowaste and treatment of biodegradable waste from 2017.

In the field of climate change and environmental protection, the possibilities for water reuse in Bulgarian agriculture have been established. SWOT and PEST analyzes were developed describing more than 50 internal and external factors influencing water reuse and stakeholder attitudes (9). The air quality in the city of Plovdiv was analyzed based on data from the Air Quality Management System (4).

#### D. SCIENTIFIC APPLIED AND APPLIED CONTRIBUTIONS

**First:** A study was carried out regarding the accumulation of heavy metals in species of the Solanaceae family (tomato, eggplant and pepper) at two sites at different distances from KCM-Plovdiv (0.5 and 1.5 km). The level of soil contamination was found to depend on the distance from the source and was very high, reaching concentrations of 630 mg Pb kg<sup>-1</sup>, 13.2 mg Cd kg<sup>-1</sup>, 60.1 mg Cu kg<sup>-1</sup>, 974 mg Zn kg<sup>-1</sup>. At the same time, it was found that a strong tendency to decrease the accumulation of heavy metals in plants with increasing distance from the factory (23). The



vegetable crops used are not suitable for growing in industrially polluted areas because they accumulate significant amounts of heavy metals in roots, leaves and fruits and are a potential threat to consumers (23).

**Second:** In an article published in *Microorganisms* (Q2, IF=4,152) on the different groups of fermentation processes and their characteristics, the nutritional and operational factors affecting the yield of microbial biomass and the metabolic activity of the inoculum, the characteristics of the final product, the strategies for their optimization etc. (7). The effect of organic, mineral and combined fertilization of potatoes on the yield and the development of the soil microbiome was established. The developed technology for recycling WWTP sludge has been applied jointly with the Plovdiv Waterworks at the point of formation in WWTP-Hisarya, WWTP-Sopot and WWTP-Karlovo. As a result, the composted sludge amounts to about 1050 t per year, and the resulting in situ vermicomposts meet the compost product requirements laid down in the Ordinance on the Separate Collection of Biowaste and Treatment of Biodegradable Waste from 2017 and are used as a quality complex fertilizer to maintain the green areas.

**Fourth:** The features of the prokaryotic microbiome in mesophilic and thermophilic habitats during biowaste composting at sites with different microclimatic characteristics were deciphered. A greater diversity of species characterizes the bacteriome of the mesophilic zones of the compost in Harmanli compared to that in Yasno Pole (Channon and Chao1 indices). The genera *Sphingobacterium*, *Sphingomonas*, *Paracoccus*, *Pseudomonas*, and *Halomonas* were most common in the composting piles in both zones, while *Streptomyces*, *Truepera*, and *Flavobacterium* were significantly more abundant in Harmanli compared to Yasno Pole (18).

**Fifth:** Through two international projects in Southern Bulgaria, the possibilities for reuse of water in agriculture, raising the awareness of the main interested parties, citizens and civil organizations have been clarified.

## 7. Critical notes and recommendations

I have no critical remarks about the candidate, except my wish that the reported results and contributions in the habilitation work be shaped as a monographic work that can be used by students and researchers in the specific cross-disciplinary field.

## 8. Personal impressions and opinion of the reviewer

I have had personal impressions of Associate Professor Stefan Shilev since 1998. I know him as a talented, thorough, searching, constructive partner. Over time, these impressions of mine have built up in a positive direction - he has developed as a resilient, socially engaged, proactive, supportive, high-goal achiever with talent, innovative thinking, ability to synergize and drive the crowd with persuasive and timely decision-making of complex environmental, social and administrative problems.

## CONCLUSION

On the basis of everything said above regarding the professional development and research qualities and achievements of associate professor Shilev, the conclusion can be made. He is a teacher, researcher, public figure, manager, innovator and motivator at the Agrarian University - Plovdiv with a clear profile and high qualifications, fully corresponding and coinciding with the theme of the announced competition for PROFESSOR. He has gained national and international fame, is highly valued and respected by partners, colleagues and students. His active research and publication activity in terms of volume, content and quality meets and exceeds the requirements for holding the position of PROFESSOR at AU-Plovdiv.

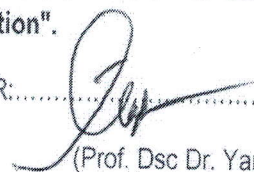
I am convinced that in the future Associate Professor Shilev will continue to develop and contribute to the Agrarian University being at the forefront of our modern education and science, widely appreciated and recognizable nationally and internationally.

All this gives me reason to positively evaluate his overall activity. I take the liberty of suggesting that the honorable Scientific Jury also vote positively. and the Faculty Council of the Faculty of Plant Protection and Agroecology. at the Agricultural University - Plovdiv to elect Associate Professor Stefan Shilev as a "professor" in the scientific specialty "Ecology and Ecosystem Protection".

Date: 9.11.2023.

City. Plovdiv

REVIEWER:.....



(Prof. Dsc Dr. Yana Topalova)