

Dmitrii Grigor'evich Zvyagintsev Turns 70



In March 2002, D.G. Zvyagintsev, Head of the Department of Soil Biology, a Doctor of Biology, an Honorary Professor of Moscow State University, and a Member of the Russian Academy of Natural Sciences, will celebrate his 70th birthday.

Zvyagintsev was born in Moscow and went to one of the best Moscow schools. He was a student and then a postgraduate student at the Department of Soil Biology, the Faculty of Biology, Moscow State University. Zvyagintsev defended his candidate science dissertation under the supervision of N.A. Krasil'nikov, a corresponding member of the Russian Academy of Sciences, and worked at the same department first as a laboratory assistant and then successively as a junior researcher, a senior researcher, and a professor. Since 1973, he has headed the Department of Soil Biology, Moscow State University. Beginning in 1999, he also became the head of the Laboratory of Soil Biology,

Institute of Soil Science of Moscow State University and the Russian Academy of Sciences.

Zvyagintsev is a prominent scientist in the field of general and soil microbiology, soil biology, biotechnology, and ecology. He is a coauthor of more than 400 scientific papers, 15 patents, 5 monographs, and 5 textbooks. Together with his collaborators and postgraduates, he has been involved in the study of many microbiological problems, such as the adhesion (adsorption or immobilization) of microbial cells on solid surfaces, the ecology of microorganisms, and biotechnology. Zvyagintsev's monograph *The Interaction of Microorganisms with Solid Surfaces* (Moscow: Mosk. Gos. Univ., 1973) was awarded the Lomonosov Prize and became a handbook to researchers in the field of soil, aquatic, and industrial microbiology. The book describes the mechanisms and strength of cell adhesion, the methods of cells desorption, and the dependence of the activity of adsorbed cells on the solid-liquid interphase conditions. It was found that most microcolonies and individual microbial cells in soil are attached to soil particles, which controls the metabolism of adsorbed cells and prevents their washing out into ground waters. Zvyagintsev emphasized that the adhesion of microbial cells to natural substrates, including insoluble nutritive ones, is of great ecological importance.

Zvyagintsev's method of direct microscopic observation of microorganisms in soil by fluorescence microscopy in reflected light allowed microbial cenoses to be studied directly in soil suspensions, soil sections, and on the surface of soil aggregates. This method is also used in many other applications.

The second important line of Zvyagintsev's research can be formulated as *the specificity of soil as a habitat of microorganisms*. He described some principles and conceptions of the structure and function of soil microbial complexes, considering soil as a multitude of microhabitats. Zvyagintsev suggested the concept of a pool of microbial cells and metabolites and put forward the principle of soil unsaturation with microorganisms, the principle of duplication, and others, which make it possible to explain some phenomena in soil and to control soil microflora under varying environmental conditions.

The results of this work were summarized in Zvyagintsev's monograph *Soil and Microorganisms* (Moscow: Mosk. Gos. Univ., 1987), which was awarded the Winogradsky Prize. The nonsaturation of soil with

microorganisms implies that it can accommodate more particular microorganisms, but only after appropriately changing the environmental conditions. The principle of duplication explains the fair stability of soil microbial complexes and their role in the maintenance of soil homeostasis. Soil represents a multitude of microhabitats greatly differing in the environmental conditions, due to which the microbial gene pool of soil is much larger than that of other environments. For long periods of time, the overwhelming majority of soil microorganisms occur in a dormant state and are activated only when the soil system must return to homeostasis.

Zvyagintsev was the first to consider *the ecology of microbial cells* in terms of general ecology and to initiate a new branch of ecology, *microbial populations in soil*. In his article "The Structural and Functional Organization of Microbial Communities," which was published in the book *The Problems of Fundamental Ecology* (1999), Zvyagintsev developed the synecology of microbial communities, including bacteria, actinomycetes, fungi, and yeasts. He revealed a vertical stratification of microorganisms in terrestrial ecosystems, beginning with the upper strata of tree crowns and ending with the lower horizons of soil and underlying rocks. The microbiocenoses of various soil horizons, which considerably differ from each other, form a conveyor for the utilization of dead organic matter and conversion of some inorganic compounds. Various terrestrial ecosystems are dominated by particular microorganisms. For instance, permafrost rocks and buried soils have been found to contain microorganisms that remain viable for several million years (this fact was listed in the Guinness Book of World Records (1991) for the longest survival of organisms on earth). The microbial biomass in soil is dominated by fungi, rather than by bacteria. Fungal melanoproteins play an important part in the genesis of humic acids in soil. The investigation of the ecology of soil fungi showed their supremacy in soils, due to which the nitrogen-fixing activity of soils is low (molecular nitrogen can be fixed only by bacteria).

The study of microbial complexes and their functioning in soil microcosms allowed some important regularities in the dynamics of microbial populations and their succession to be established under varying environmental conditions (soil moisture content, temperature, nutrition, pH, etc.). Zvyagintsev substantially contributed to the investigation of the interaction of soil microorganisms with plants and soil invertebrates and concluded that these interactions control the functioning of biocenoses. The traditional trophic (or energetic) approach to the study of microbiocenoses turned out to be less efficient than the study of biotic interactions in these biocenoses.

The investigation of the enzymatic activity of soils showed that they contain a great number of extracellu-

lar immobilized enzymes, which play an important part in the biochemical processes occurring in soil and in the maintenance of soil microbial complexes.

Overall, 15 new methods of soil microbiology have been devised by Zvyagintsev and his collaborators.

During an almost 30-year leadership of the Department of Soil Biology, Zvyagintsev created his school of soil microbiologists and ecologists. At present, the professional staff of the department includes eight doctors of biology and 12 candidates of science who carry out active research work in different fields of soil microbiology and teach students and postgraduates. Zvyagintsev organized several new courses of lectures, such as *Soil Biology*, *General Ecology*, *The Ecology of Soil Microorganisms*, and *The Problems of Modern Soil Microbiology*. About 400 soil microbiologists and 150 candidates of science graduated from the department. Under the guidance of Zvyagintsev, 50 postgraduates defended their candidate dissertations and 12 became doctors of biology.

The department is regularly involved in organizing conferences and symposia on soil microbiology. Zvyagintsev was Vice President of the Committee of Soil Biology at the International Society of Soil Scientists, Chairman of the Moscow Division of the All-Union Society for Microbiology, and a member of the Commission of Experts at the All-Union Certifying Commission. At present, he is Chairman of the Commission for Soil Biology and a member of the Central Committee and Presidium of the Dokuchaev Society for Soil Science, a member of several scientific coordination councils at the Russian Academy of Sciences and Moscow State University, Chairman of the Dissertation Council for Microbiology and Agrochemistry at the Moscow State University, a member of the Editorial Boards of the Russian journals *Microbiology* and *Soil Science*, and Deputy Editor-in-Chief of the journal *Herald of Moscow University* (series 17).

Zvyagintsev has given lectures in Japan, United States, Cuba, and Czech Republic. Along with the two aforementioned monographs, he wrote or edited the books *Microorganisms and Soil Protection*, Moscow: Mosk. Gos. Univ., 1989; *Methods in Soil Microbiology and Biochemistry*, Moscow: Mosk. Gos. Univ., 1991; *Microorganisms in Permafrost*, Harwood, 1995; *Microbial Succession in Soil*, Harwood, 1995 (with L.M. Polyanskaya as the coauthor); and *The Ecology of Actinomycetes*, Moscow: GEOS, 2001 (with G.M. Zhenova as the coauthor).

The colleagues and pupils of Zvyagintsev appreciate his professionalism, erudition, benevolence, and kind humor, which are so necessary for fruitful work. We wish him health, long life, and further success in his scientific career.

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