

## USSR Prominent Allelopathy Scientists- Part III (1926-2010)

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### ABSTRACT

The article describes the outstanding results of a long cycle of research (main achievements and theoretical and practical developments) for the period 1904-2019 on the issues of allelopathy by scientists of the Soviet period of the USSR. The main biographical data and achievements of scientific activity of outstanding Soviet scientists in the field of allelopathy are given: Andrei Mikhailovich Grodzinsky, Givi Alexandrovich Sanadze, Yulian Andriyovich Zlobin, Erast Anatoliyovych Golovko, Larisa Dem'yanivna Yurchak. Scientists of this period significantly deepened the mechanism of allelopathic interaction of plants. In accordance with the results of A.M. Grodzinsky's research, a holistic scientific concept of allelopathy was formed and fully detailed, which included the entire spectrum of active allelochemicals - volatile phytoncides, root soil extrudates derived from the immobilization of plant residues. The existence of the soil fatigue mechanism was formulated and proved, on the basis of which agrotechnological approaches to the formation of crop rotations, the creation of complex polyphyllous crops, phytodesign and the formation of highly productive agricultural landscapes, the use of the identified mechanisms of allelopathic effects in the formation of biological protection (herbicide-free control) were formed. The methodology of laboratory and field study of allelochemicals in the application of various practices was significantly deepened in terms of plant species, soil type and the nature of the soil and climatic regime of the territories. These developments in terms of detailing allelochemicals and their resulting effects and aftereffects in the census of different plant species and cenotic systems of varying complexity and tiering were deepened by Grodzinsky's scientific followers and students - E.A. Golovko and L.D. Yurchak. G.A. Sanadze's research deepened Tokin's phytoncidal theory by studying the complex mechanism of plant interaction through volatile biologically active secretions (the isoprene theory is generally recognized in the world). Another scientist Y.A. Zlobin developed the concept of the vitalized structure of plant cenopopulations, which is still used by scientists around the world to assess species competition and the viability of plant populations and is a format for the structural morphometric response of plants and their blends to different levels of allelopathic interaction.

**Key words:** Allelopathy, Allelopathy scientists, Biography, Golovko, Grodzinsky, Sanadze, Yurchak, Zlobin.

## 1. INTRODUCTION

The scientific vision of the biological laws of the world is changing and this is associated with details of processes of the existence of living organisms and complex interactions between them. The transition from the isolation of biological objects in existing systems in certain habitats, based on their mutual influences in the biogeocenosis is basic methodological approach. Perception of development of managed biological systems is to ensure the preservation of biodiversity. Allelopathic research is becoming increasingly important in this regard, it is becoming more complicated, has completely new look at the processes. Allelopathic research is mandatory to establish the biological and economic efficiency of various agrophytocenoses, biological control of agricultural pests (Weeds, Insects, Nematode, Fungi) without use of agrochemicals, development of ecologically balanced biogeocenoses in different ecosystems and prevention of allergic reactions etc. (85)

## 2. BIOGRAPHIES OF PROMINENT ALLELOPATHY SCIENTISTS (1904-2019)

### 2.1. Andrei Mikhailovich Grodzinsky (1926-2010)

Academician of the Academy of Sciences of the USSR, Doctor of Biological Sciences, Professor, Academician-Secretary of the General Biology Department of the USSR Academy of Sciences, Member of the Presidium of the USSR Academy of Sciences, Director of the Central Republican Botanical Garden of the USSR Academy of Sciences, Chairman of the Botanical Gardens of Ukraine and Moldova, Laureate of the State Prize of Ukraine in the field of science and technology (1992) (posthumously). He not only developed the Soviet and world botanical school with scientific methods, ideas, hypotheses, but also is the founder of world research on allelopathy, the results of which have influenced the current level of this science.

**Early life and education:** Andriy Mykhailovych Hrodzinsky was born on December 3, 1926 in Bila Tserkva, Kyiv region, in the family of the dean of the agrochemical faculty of the Bila Tserkva Agricultural Institute. He began his career in 1942 as an employee of the agrochemical laboratory of the Kazakh Research Institute of Agriculture. After studying at the Agricultural College and serving in the Soviet Army, he entered first the Moscow Agricultural Academy and later the Bila Tserkva Agricultural Institute, graduating with honors in 1954.

**Professional life and contributions to allelopathy:** (based on publications 1-3, 5-12,47,48,56,74,76,78). In 1955, A.M. Grodzinsky became a graduate student of the Institute of Plant Physiology and Agrochemistry of the USSR Academy of Sciences. In 1958 he successfully defended his dissertation 'Receipt and movement of nutrients in plants under the influence of tillage and fertilizers', working as a junior researcher at the Institute of Botany of the USSR Academy of Sciences. The first publications concerned the mechanisms of physiological action of allelopathic substances, which the German scientist G. Grummer called colins. A.M. Grodzinsky scientifically defined their formation as a mixture of physiologically active substances secreted by plants or in their immediate environment, due

to the action of heterotrophic organisms or physicochemical factors and have a positive or negative effect on neighboring plants (may affect the plant that isolated them). In particular, scientists analyzed the cycle of substances of allelopathic action called colins in application to the biogeocenotic system and the mechanism of their action depending on the biological structure of the plant group (30,32), which allowed to detail the structure of donor-acceptor relationships in plant-soil-plant-plant interaction, soil root secretions, volatile terrestrial secretions and products of their soil-atmospheric transformation (31,35,37). The current state of allelopathic research and the history of the development of knowledge about the chemical interaction of plants A.M. Grodzinsky described as the intensive development and formation of the third paradigm of allelopathy. The current state of allelopathic research and the history of the development of knowledge about the chemical interaction of plants A.M. Grodzinsky described as the intensive development and formation of the third paradigm of allelopathy. The first paradigm interprets allelopathy as a negative impact of some plants on others, the second - allelopathically active is the whole set of secretions from plant roots and their effect is mostly nonspecific. Regarding the third paradigm, it considers allelopathic factors as signals of a specific type, 'microeffectors' that can affect the growth and development of plants as well as environmental factors. A.M. Grodzinsky was the first to formulate the principles of donor-acceptor interaction in biogeocenoses through root secretions, products of vital activity of soil microflora (36) (Figure 2). Therefore, the task of scientists under the leadership of A.M. Grodzinsky was primarily to study the total action of the colins to understand the real chemical interaction that occurs in nature.

A.M. Grodzinsky drew up a scheme of donor-acceptor interaction of plants in biogeocenoses through root secretions, volatile phytogetic (phytoncide) compounds and products of biochemical activity of soil microorganisms; established the function of allelopathy in the formation of the structure, stability and productivity of phytocenoses. Philosophical definition of the essence of allelopathy (cycle of physiologically active substances that regulate internal and external relationships, renewal, development and change of vegetation in biogeocenoses).



Figure 1. Professor Andrei Mikhailovich Grodzinsky at the laboratory.

Scientists have deepened the issue of soil fatigue both from the standpoint of continuous cultivation of certain plant species and from the standpoint of assessing their allelopathic impact on soil biota and the degree of accumulation of biologically active substances during

growth and development. Grodzinsky also studied the regularities of successful construction of multicomponent cenoses (blends) of various purposes both in the practice of field crop production and fodder production and in the field of formation of landscape associations of different age plant species (34,42) developing early theories of allelopathic interactions in blend cenosis of different plant species (45,46). This allowed him to develop a scientific concept of allelopathy as a cycle of physiologically active substances in the biogeocenosis, which play the role of regulator of internal and external relationships and are the causes of balance, stability, and change of plant communities called Grodzinsky's scheme (Figure 2) (33,39). Fundamental developments were made by Grodzinsky in the field of biological control of weeds in agrocenoses with an assessment of the level of antagonism, neutrality and stimulation, which became the basis for the development of modern systems of biological (herbicide-free) control of coenoses (40,41). In 1965, A.M. Grodzinsky was appointed Deputy Director of the Institute of Botany of the USSR Academy of Sciences, the same year he became the director of the CRBS of the USSR Academy of Sciences and defended his doctoral dissertation on 'Allelopathy in the life of plants and their groups'. In the same year a monograph with the similar title of 1965 of the monograph 'Allelopathy in the life of plants and their communities', 'Fundamentals of chemical interaction of plants.

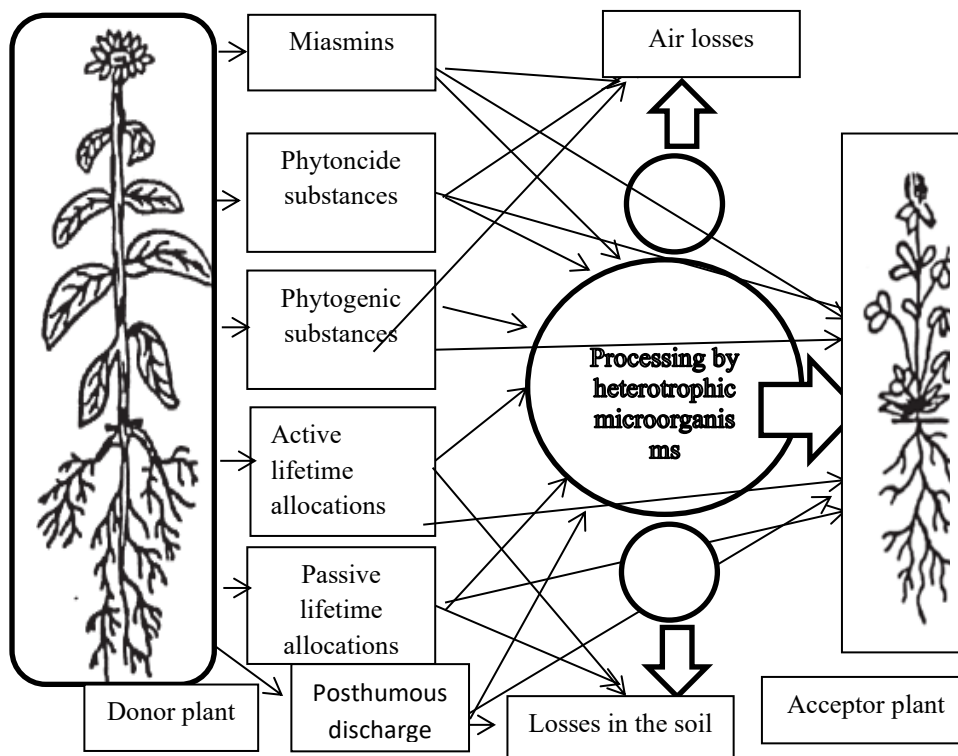


Figure 2. Scheme of allelopathic influence of plants (A.M. Grodzinsky (32)).

Table 1. Chronology of main events

Dates	Events
1926	Born on December 3, 1926, in Bila Tserkva (Ukraine)
1942	He began his career at the age of 16
1943-1945	Student of Kolodez Agricultural College (agronomy)
1945-1948	Service in the army
1948-1950	Student of the correspondence department of the Moscow Agricultural Academy named after KA Timiryazeva (agronomic department)
1950-1954	Student of the agronomic faculty of Bila Tserkva Agricultural Institute
1954-1955	District agronomist of Kozelets forest reclamation station
1955-1958	Postgraduate student of the Institute of Plant Physiology and Agrochemistry of the USSR Academy of Sciences
1957-1958	Junior researcher of the Department of Plant Physiology of the Institute of Botany of the USSR Academy of Sciences
1958	Defense of the candidate's dissertation 'Receipt and movement of nutrients in plants under the influence of tillage and fertilizers'
1965	Defense of doctoral dissertation. Publication of the monograph 'Allelopathy in the life of plants and their communities. Fundamentals of chemical interaction of plants'
1965	Deputy Director of the Institute of Botany of the USSR Academy of Sciences, and later Director of the Central Republican Botanical Garden of the USSR Academy of Sciences
1967	Assignment of the title of professor and election of the chairman of the Council of Botanical Gardens of Ukraine
1970	Official establishment of the Department of Allelopathy within the Central Republican Botanical Garden of the USSR Academy of Sciences
1973	Election as a corresponding member of the Academy of Sciences of the USSR, the book 'Fundamentals of chemical interaction of plants' was published
1974	Election to the position of Academician-Secretary of the Department of General Biology of the Academy of Sciences of the USSR
1979	Election as an academician of the Academy of Sciences of the USSR
1983	Official renaming of the Department of Ecology and Plant Physiology of the Central Republican Botanical Garden of the Academy of Sciences of the Ukrainian SSR to the Department of Allelopathy
1979-1984	Specialist (Plant Physiology), for higher education
1977-1984	Work in specialized scientific councils and the expert council of the Supreme Attestation Commission of the USSR
1988	Expired on 17 December, 1988

Andriy Mykhailovych devoted his further scientific activity to the study of the peculiarities of allelopathy in different types of vegetation and different phytocenochemical interactions of plants, mechanisms of action of biologically active substances, knowledge of the peculiarities of allelopathy in different types of vegetation. He paid special attention to the study of the peculiarities of allelopathic interaction in different types of vegetation and different phytocenoses. The results of many years of research were published in the monograph 'Fundamentals of chemical interaction of plants', published in 1973. The author gives a scientific definition of allelopathically active substances - colins as a mixture of physiologically active substances released by plants or formed in their immediate

environment due to heterotrophic organisms, physicochemical factors and positively or negatively affect other plants or the same plant that induces them. The nature of the compounds that form the colins is complex and changeable, the acceptor plant perceives them as a whole – therefore, the inactive components of this mixture can enhance or weaken the action of physiologically active substances. The main task of allelopathy A.M. Grodzinsky considered the study of the total action of the colins and the disclosure of the mechanisms of real interaction of plants, which occurs in nature.

He developed the latter direction with recommendations for the use of greens, plant by-products, mulching, cycles of natural processes and geospatial theories, etc. (37,41). He found that the use in the structure of crop rotations fodder-sidereal type (rapeseed, mustard, white mustard, oilseed radish) allows ensuring balanced soil nutrition of major crops, stabilization of the accumulation of organic matter in the soil profile, which reduces the overall soil, provides optimization of soil, reducing the allelopathic aftereffect with constant crops. These facts are confirmed today by the latest research (57). He began to study the allelopathic potential of the flora of Ukraine.

Scientists have developed a huge methodological basis for allelopathic research, methods of laboratory and field studies of allelopathic interaction, identification of physiologically active compounds and their effects on different plant species, bio testing of allelopathic action, chromatography of physiologically active substances (3). It was indicated (29,43) that Grodzinsky established biotests for determining allelopathic activity of substances released from living plants, their residues or their products transformed and accumulated in the soil.

One of the universal tests developed was the seed germination test of *Raphanus sativus* 'Karashii' where the results could be obtained within 15-18 h. He developed a scale using the relative germination vigour (mg/l or mg/kg) of a retardant which is equal to the effect of coumarin. These biotests were studied using seeds of other species and dormant buds of the roots and leaves. Using biotests, more than 800 plants species (including 200 weed species) were studied for their allelopathic activity. He concluded that all plants released biologically active substances but their amount and activity varied. The allelopathic activity depends on the mode of plant reproduction. He analysed steppe plant communities and classified them in three groups of allelopathically active plant species as under (25):

(i). **High active specie:** These form an highly active allelopathic environment and thereby depress other species and invade other herbaceous zones. However, they also create unfavourable conditions for their own species and thus often change their habitat. These plants grow separately from each other and do not form a dense canopy, hence, such species are not dominant in communities.

(ii). **Moderately active specie:** These are vegetatively propagated e.g. *Agropyron repens* and have allelopathic potential to eliminate other species. These species form the communities with a tendency of permanent habitat. After higher accumulation of allelopathic compounds in the soil and environment, these plants start shifting from the centre of the community to periphery and in the vacated land new species invade and begin growing. These new species are more tolerant to the kolines.

(iii). **Less active specie:** These species dominate the stable phytocenosis and produce such allelopathic conditions that prevent the invasion of non-tolerant species and avoid build up of autotoxicity. Therefore, these species are long living in their habitat.

It was shown that allelopathic activity is a stable sign of the plant species and its individual plants. It was presumed that certain genes were responsible for allelopathy and their identification could help in selection of desirable plants.

A.M. Grodzinsky continued the work of M.G. Kholodny and many years ahead of foreign scientists who studied the chemical interaction of plants from the standpoint of toxic allelochemistry (12). Studying the chemical interaction in phytocenosis, based on experimental data and literature sources, Grodzinsky described 15 different mechanisms of allelopathic action of some plants on others.

Andriy Mykhailovych's contribution to the development of theoretical and methodological issues of plant introduction and acclimatization, ecology, nature protection, increase of soil fertility, weed control, introduction of new fruit and agricultural crops, flower and ornamental plants is important. From 1967 he headed the Council of Botanical Gardens of Ukraine and Moldova, paying special attention to biodiversity conservation, introduction and acclimatization of new species, breeding activities, creating a network of botanical gardens of Ukraine. In 1967, A.M. Grodzinsky was awarded the title of professor and elected chairman of the Council of Botanical Gardens of Ukraine.

In 1973, Andrei Mikhailovich was elected a corresponding member of the USSR Academy of Sciences, and in 1979 - a full member of the USSR Academy of Sciences. From 1974 until the end of his life he worked as an academician-secretary of the Department of General Biology of the USSR Academy of Sciences. From 1967 he headed the Council of Botanical Gardens of Ukraine and Moldova, paying special attention to biodiversity conservation, introduction and acclimatization of new species, breeding activities, creating a network of botanical gardens of Ukraine.

In the period 1974-1980, the scientist's attention was focused on the study of allelopathic soil fatigue in natural and cultural phytocenosis, as allelopathic interaction occurs through the soil.

The obtained experimental data in different types of agrophytocenosis became the basis for the collective monograph 'Allelopathic Soil Sickness' published in 1979. Grodzinsky and his students actively developed a methodology for the study of allelopathic soil Sickness and substratum, allowing the selection and identification of active phytotoxic substances from the soil. he was the first in the former USSR to develop the foundations and prospects for the development of scientific and practical direction - to use plants in ergonomic systems and interiors, calling it phytodesign. He also made significant contributions in the field of space biology, from working hypotheses and laboratory experiments to his proposed orchids for orbital stations (38).

According to a number of publications (5-13,20,51-54,84) A.M. Grodzinsky was famous in the world. He maintained a creative relationship with a professor at the University. J. Purkini (Brno, Czech Republic) - Z. Lastuvka; Dr. A. Dynich and Professor V. Mysic (Institute of Biological Research, Belgrade, SFRY - former Yugoslavia); with Professor E. Rice and Professor J. Waller (USA).

Table 2. Books of Professor Grodzinsky on allelopathy (Golovko *et al.*, 1995 (25)).

S. No	Year	Author and Title
1.	1965	Grodzinsky, A.M. <i>Allelopathy in plant life and their communities</i> . 200 pp.
2.	1970	Grodzinsky, A.M. <i>Physiological and Biochemical Basis of Interactions between Plants in Phytocenosis</i> . Vol. 1. 324 pp.
3.	1971	Grodzinsky, A.M. <i>Physiological and Biochemical Basis of Interactions between Plants in Phytocenosis</i> . Vol. 2. 220 pp.
4.	1972	Grodzinsky, A.M. <i>Physiological and Biochemical Basis of Interactions between Plants in Phytocenosis</i> . Vol. 3. 160 pp.
5.	1973	Grodzinsky, A.M. <i>Physiological and Biochemical Basis of Interactions between Plants in Phytocenosis</i> . Vol. 4. 156 pp.
6.	1973	Grodzinsky, A.M. <i>et al. Foundations of chemical interactions between the plants</i> . 206 pp.
7.	1974	Grodzinsky, A.M. <i>Physiological and Biochemical Basis of Interactions between Plants in Phytocenosis</i> . Vol. 5. 136 pp.
8.	1975	Grodzinsky, A.M. <i>Physiological and Biochemical Basis of Interactions between Plants in Phytocenosis</i> . Vol. 6. 148 pp.
9.	1976	Grodzinsky, A.M. <i>Problems of Allelopathy</i> .
10.	1979	Grodzinsky, A.M. <i>et al. Allelopathy and Soil Sickness</i> . 248 pp.
11.	1981	Grodzinsky, A.M. <i>Chemical Interactions in Plants</i> .
12.	1982	Grodzinsky, A.M. <i>et al. Allelopathy in Natural And Artificial phytocenosis</i> . 200 pp.
13.	1982	Grodzinsky, A.M. <i>et al. Role of Allelopathy In Aquatic Plants</i> . 184 pp.
14.	1982	Grodzinsky, A.M. <i>et al. Proceedings V Conference on problems of allelopathy (Abstracts)</i> . 188 pp.
15.	1983	Grodzinsky, A.M. <i>et al. Role of Plant and Microbial Toxins in Allelopathy</i> . 152 pp.
16.	1987	Grodzinsky, A.M. <i>Experimental Allelopathy</i> . 236 pp.
17.	1989*	Grodzinsky, A.M. <i>Methodological problems in Allelopathy</i> .
18.	1990*	Grodzinsky, A.M. <i>Allelopathy and Productivity of Plants</i> . 148 pp.
19.	1991*	Grodzinsky, A.M. <i>Allelopathy of Plants and Soil Exhaustion</i> . 431 pp.
20.	1991*	Grodzinsky, A.M. <i>et al. Dictionary-reference book on Agrophytocenology and Meadow Science</i> . 136 pp.
21.	1992*	Grodzinsky, A.M. <i>Interaction of Volatile Emissions in Closed Ecosystem</i> . 127 pp.

All Books are in Russian language and published by Publishing Naukova Dumka (in Russian), Kiev. \*published after the death of Prof. Grodzinsky.

To adopt the foreign experience of A.M. Grodzinsky visits Germany and the United States and participates in scientific conferences. The scientist carried out active work on editorial and publishing activities. He was a member of the editorial boards of a number of journals: 'Bulletin of the USSR Academy of Sciences', 'Ukrainian Botanical Journal', 'Reports of the USSR Academy of Sciences. Series B', 'Knowledge and Work', a collection of 'Introduction and acclimatization of plants in Ukraine', 'Red Book of the Ukrainian SSR'; editor-in-chief of many monographs; founder and editor of the interdepartmental collection 'Physiological and biochemical bases of plant interaction in phytocenoses' and others. He was the initiator and host of the TV show 'In the World of Plants', which was broadcast in 1973-1978 and enjoyed great popularity among viewers. In addition, he created the popular

science film 'Learning the Alphabet of Nature' (1981) and the book 'Among Nature and in the Laboratory' (1983).

Andriy Mykhailovych brought up a whole school of scientists. Under his leadership, 5-doctors and more than 50 candidates of science were trained. He wrote 7 monographs, more than 300 scientific and scientific-journalistic works. He was the editor-in-chief of the journal 'Physiology and Biochemistry of Cultivated Plants', the republican interdepartmental collection 'Introduction and Acclimatization of Plants', a member of the editorial boards of a number of All-Union and republican journals, and the 'Red Book of the Ukrainian SSR'.

For fruitful scientific activity, active participation in the development of biological sciences A.M. Grodzinsky received a number of awards, including the 'Order of the Badge of Honor', the 'Medal for Valiant Work', and the 'Prize named after M.G. Kholodny for a series of works on experimental botany and many others.

Died A.M. Grodzinsky on December 17, 1988 at the age of 62, after a serious illness. He was buried in the Baykovo Cemetery in Kyiv.

**PUBLICATIONS:** Prof. Grodzinsky published about 100 research papers, several bulletins and 19 books on allelopathy (Table 2), besides many books on General Botany, etc.

### **Research Papers**

The full list of the scientist's publications can be found at (1, 76).

### **2.2. Givi Alexandrovich Sanadze**

Early life and education (based on the results of the article (55)): He was born on June 30, 1929 in Tbilisi. His father (Adeksander Sanadze) was a professor of botany, and his mother (Maria Sanadze) was an associate professor in the field of plant anatomy. She owes the honor of discovering the leaf mesophyll covering cells, the biological role of which became clear only after the discovery of the C<sub>4</sub> type of photosynthesis.

In 1937, Sanadze entered school, but was soon expelled as the son of an "enemy of the people." After the decline of political terror, he got the opportunity to continue his schooling.

**Professional life and contributions to allelopathy:** Sanadze graduated from high school and entered the biological faculty of the I. Javakhishvili Tbilisi State University in 1947. As a second year student, he was awarded the All-Union Prize for studying the role of UV in plant organogenesis, which allowed him to continue this work in the laboratory of photosynthesis at the BIN RAS (Leningrad).

In 1953 he was recruited to the Institute of Botany of the Georgian Academy of Sciences for a temporary position as a seasonal worker. At the end of 1953 he was offered the position of a junior researcher to deal with the problem of allelopathy little known at that time. Sanadze first reported that plant leaves emit saturated hydrocarbons (methane, ethane, propane) in 1956. He announced the discovery of a new phenomenon of light-dependent release of isoprene in 1957.



Figure 3. Givi Alexandrovich Sanadze.

Sanadze defended his Ph.D thesis at the Institute for Fundamental Research of the USSR Academy of Sciences in Moscow in 1959. From 1964 to 1967 he continued the study of biogenic isoprene and in 1968 at the same institute defended his doctoral dissertation on the topic "Biosynthesis and release of isoprene by leaves in the light". Since 1968 Sanadze has been working as a professor at the Department of Plant Physiology at Tbilisi State University. At the same time, he created the problem laboratory of photosynthesis, in which, together with a group of young scientists, he continued to study the isoprene effect.

Since 1968 G.A. Sanadze is a participant in many international conferences, symposia and congresses. In 1978, the Massachusetts scientific community was nominated for the Nobel Prize. In 1979 G.A. Sanadze was elected a corresponding member of the Georgian Academy of Sciences. In 1982, at the invitation of the University of Massachusetts, he was in the United States for six months. During this time, he attended more than 20 American universities with lectures.

In 1983 G. Sanadze was elected an academician of the Georgian Academy of Sciences. In the same year, he headed the Department of Plant Anatomy and Physiology at Tbilisi State University. During 1988-2000 he was vice-president of the Georgian Academy of Sciences. In 1990, a major symposium on biogenic isoprene was held in San Francisco, after which interest in the study of this problem increased on a global scale.

Sanadze devoted his scientific activities to the study of the photobiological phenomenon discovered by him in the 50s of the last century - light-dependent synthesis and release of isoprene by plant leaves (61). He established a number of scientific facts related to the release of light hydrocarbons and volatile terpenoids by plant leaves, which allowed him to substantiate the presence of an excretory function in leaves and to put forward a hypothesis about the existence of a second carboxylating complex in photobiosynthesis. He also showed the important regulatory function of CO<sub>2</sub> in cell metabolism and explained the thermodynamic nature of the discharge (dissipation) of excess free energy, which inevitably arises in thermodynamic flows far from the equilibrium of irreversible processes (62-69). Currently Sanadze considers the release of biogenic isoprene as a special case of the manifestation of the fundamental property of dissipation of the entropy of a living system, which as a whole provides a stable stationary state of the cell (70-72).

Table 3. Chronology of main events

Dates	Events
1929	Born June 30, 1929 in Tbilisi (Georgia).
1930-1947	Studying at school
1947-1952	Student of the biological faculty of I. Javakhishvili Tbilisi State University
1953-1959	Junior researcher to deal with the problem of allelopathy in Institute of Botany of the Georgian Academy of Sciences
1959	Defended Ph.D thesis at the Institute for Fundamental Research of the USSR Academy of Sciences in Moscow
1968	Defended doctoral dissertation 'Biosynthesis and release of isoprene by leaves in the light'. Professor at the Department of Plant Physiology at Tbilisi State University
1979	Corresponding member of the Georgian Academy of Sciences
1982-1983	Teaching at American universities
1983	Academician of the Georgian Academy of Sciences. Headed the Department of Plant Anatomy and Physiology of the Georgian Academy of Sciences
1988-2003	Vice-president of the Georgian Academy of Sciences
From 2003	Active scientific and teaching activities

The pioneering works of Sanadze and his leadership in elucidating the biological role of the discovered phenomenon were indisputable and received international recognition. The evidence of the high scientific authority of G.A. Sanadze in the world community of scientists was the publication by the editor-in-chief of the well-known international journal (74) devoted to the discovery and contribution of G.A. Sanadze in the study of the formation of isoprene in plants. The author of the discovery, as a result of many years of research, proposes a hypothesis based on the well-known property of the dissipation of the cell as a self-organizing system. The meaning of the hypothesis lies in the application of this biochemical reaction by the plant both to a method for removing an excess amount of hydrocarbons formed during photosynthesis and to the use of isoprene as an additional regulator compound (73). Through his research, the scientist deepened the phytoncide Tokin's theory of plant relationships in the cenosis and the influence of species in a single cenosis due to volatile biologically active secretions.

#### PUBLICATIONS:

##### Books/Monographs

- (i). Sanadze, G.A. (1961c). *The release of volatile organic substances by plants*. 196 pp. Tbilisi: Publishing house of the Academy of Sciences of the Georgian SSR (Russian).
- (ii). Sanadze, G.A. (1961d). *The Excretion of Volatile Organic Substances by Plants*. 92 pp. Tbilisi. Issue of Academy of Sciences of the Georgian SSR (Russian).

##### Research Papers

- (i). Sanadze, G.A. (1957). Emission of organic matter by leaves of *Robinia pseudoacacia* L. *Bulletin Academy of Sciences GSSR* **19**: 83-86 (Russian).
- (ii). Sanadze, G.A. (1959). Role of light in formation of volatile organic products of matter change in plants. *Bulletin Academy of Sciences GSSR* **XXII**(4): 449-454 (Russian).

- (iii). Sanadze, G.A. (1960). On the chemical nature of the volatile secretions of leaves. *Phytoncides in medicine, agriculture and food industry: materials of the III meeting June 22-25, 1959* p. 22. Kiev (Russian).
- (iv). Sanadze, G.A. (1960). On the chemical nature of the volatile secretions of leaves. In: *Phytoncides*. p. 22-24. Kiev.
- (v). Sanadze, G.A., (1961). Release of volatile organic compounds by Plants. In: *Weed plants of the USSR, 1934-1936* pp. 1-4. Tbilisi. Academy of Sciences of the Georgian Academy of Sciences (Russian).
- (vi). Sanadze, G.A. (1961a). Release of volatile substances by plants. In: *Weed plants of the USSR, 1934-1936* pp. 5-8. Tbilisi. Academy of Sciences of the Georgian Academy of Sciences (Russian).
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### 2.3. Yulian Andriyovich Zlobin

Professor, Doctor of Biological Sciences, Honored Worker of Science and Technology of Ukraine, Academician of the International Academy of Human Problems.

**Early life and education** (formed on the basis of publications (58)): He was born on April 2, 1932 in Novosibirsk (Russia). In 1950 he graduated from high school in Armavir, Krasnodar Krai with a medal. In 1950-1954 he was a student of the Faculty of Natural Sciences of the V.I. Lenin Moscow State Pedagogical Institute. During 1954-1957 he studied in graduate school at the Department of Botany of the V.I. Lenin Moscow State Pedagogical Institute.

**Professional life and contributions to allelopathy:** During 1957-1962 he worked as a senior lecturer at the Department of Botany and Plant Physiology of the Tyumen State Pedagogical Institute.



Figure 4. Yulian Andriyovich Zlobin

In 1961 he defended his dissertation for the degree of Candidate of Biological Sciences at Lomonosov Moscow State University. In 1962 he was appointed head of the Department of Botany of the Mari State Pedagogical Institute. In the period 1963-1968 he was dean of the Faculty of Natural Sciences of the Mari State Pedagogical Institute. During 1968-1980 he worked at the Ulyanovsk Agricultural Institute as an associate professor of botany, then head of the botany department. In the period 1971-1976 he was the dean of the agronomic faculty of the Ulyanovsk Agricultural Institute. In 1977 he defended his dissertation for the

degree of Doctor of Biological Sciences at Leningrad State University and in 1978 received a degree. In 1979 he was awarded the academic title of Professor of Botany and Plant Physiology of Ulyanovsk Agricultural Institute.

Table 4. Chronology of main events

Dates	Events
1932	Born on April 2, 1932 in Novosibirsk (Russia)
1939-1950	Schooling
1950-1954	Student of the Faculty of Natural Sciences of the V.I. Lenin Moscow State Pedagogical Institute
1954-1957	Studied in graduate school at the Department of Botany of the V.I. Lenin Moscow State Pedagogical Institute
1957-1962	Worked as a senior lecturer at the Department of Botany and Plant Physiology of the Tyumen State Pedagogical Institute
1961	Defended his dissertation for the degree of Candidate of Biological Sciences at Lomonosov Moscow State University (' <i>Living Cover of Spruce Forests as A Factor of Natural Regeneration of Spruce</i> ')
1962	Head of the Department of Botany of the Mari State Pedagogical Institute
1963-1968	Dean of the Faculty of Natural Sciences of the Mari State Pedagogical Institute
1968-1980	Worked at the Ulyanovsk Agricultural Institute as an associate professor of botany, then head of the botany department
1977	Defended dissertation for the degree of Doctor of Biological Sciences at Leningrad State University
1979	Awarded the academic title of Professor of Botany and Plant Physiology of Ulyanovsk Agricultural Institute
1980-2010	Worked in the Sumy branch of the V.V. Dokuchaev Kharkiv Agricultural Institute., which was successively reformed into the Sumy State Agricultural Institute
1998-2008	Vice-Rector for Academic Affairs and part-time Head of the Department of Botany and Physiology of Agricultural Plants in Sumy State Agricultural Institute
Since 2008	Professor at the Department of Botany and Physiology of Agricultural Plants of Sumy National Agrarian University

During 1980-2010 he worked in the Sumy branch of the V.V. Dokuchaev Kharkiv Agricultural Institute., which was successively reformed into the Sumy State Agricultural Institute, and then into the Sumy National Agrarian University. In the period 1980-1998 he held the position of Vice-Rector for Academic Affairs and part-time Head of the Department of Botany and Physiology of Agricultural Plants, and in 1998-2008 he was the Head of the Department of Botany and Physiology of Agricultural Plants of the same university. Since 2008 he has been working as a professor at the Department of Botany and Physiology of Agricultural Plants of Sumy National Agrarian University.

The scientist supported the idea of studying coenotic connections and through them the influence of different plant species on each other and variants of their coexistence in phytocenoses of different types. As a result of many years of research Zlobin developed an original concept of vitality structure of plant populations, he identified patterns of coexistence of populations, made a significant contribution to the quantitative morphology of plants, established a number of patterns of population structure of forest groups,

conducted a detailed study of population populations of 15 useful meadow plants, hayfields and pastures (86-91).

Scientists have obtained fundamental results in the field of plant population biology. The fundamentals of complex phytopopulation analysis have been developed. Created and substantiated the concept of plant vitality as a way to assess their viability based on the morphometric method and computer technology. His authorship belongs to the system of indicators of vitality competition between species both in the form of morphometric reactions and in the form of chemical interactions of different nature. He developed the foundations and methods of morphometric and competitive-species analysis of plants. A significant contribution has been made to solving the problems of plant reproduction, coenotic tension, plant survival, the formation of the layering of phytocenosis.

**PUBLICATIONS:** Author of more than 300 scientific and methodological publications, including four monographs, three textbooks and 10 textbooks.

#### **Books/Monographs**

- (i). Zlobin, Yu. A. (1960). *Living Cover of Spruce Forests as A Factor of Natural Regeneration of Spruce* 43 pp. Tyumen: Tyumen Book Publishing House.
- (ii). Zlobin, Yu. A. (1984). *Cenopopulation Analysis in Phytocenology*. 60 pp. Vladivostok: Publishing House of the Academy of Sciences of the USSR (Russian).
- (iii). Zlobin, Yu. A. (1984). *Cenotic Plant Populations*. 52 pp. Vladivostok: Publishing House of the Academy of Sciences of the USSR (Russian).
- (iv). Zlobin, Yu. A. (1986). *Agrophytocenology: textbook*. 74 pp. Kharkov: V.V. Dokuchaeva Kharkiv Agricultural Institute. (Russian).
- (v). Zlobin, Yu. A. (1989). *Principles and Methods of Studying Plant Cenopopulations*. 146 pp. Kazan: Kazan State University (Russian).
- (vi). Zlobin, Yu. A. and Prasol, V.I. (1993). *Periodization of Ontogenesis of Cultivated and Weed Plants*. 66 pp. Sumy: Sumy Agricultural Institute (Russian).
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- (viii). Zlobin, Yu. A. (2009). *Population Ecology of Plants: Current State, Points of Growth: Monograph*. 265 pp. Sumy: University book (Russian).

#### **Research Papers**

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- (vii). Zlobin, Yu. A. (1971). Interspecies relationships and the nearest neighbor method. In: *Quantitative Methods of Vegetation Analysis* pp. 115-122. Riga (Russian).
- (viii). Zlobin, Yu. A. (1974). Using the factor analysis technique to study the phytocenotic structure of the living ground cover in the forest. In: *Quantitative Methods for Vegetation Analysis* pp. 10-12. Ufa (Russian).
- (ix). Zlobin, Yu. A. (1976). Study of the mechanisms that determine interspecific associations and phytocenotic structure of the vegetation cover. *Botanical Journal* **61**(4): 466-479 (Russian).
- (x). Zlobin, Yu. A. (1978). On the inequality of individuals in plant populations. In: *Structural and Functional Features of Natural and Artificial Biogeocenosis* pp.12-14. Dnepropetrovsk (Russian).
- (xi). Zlobin, Yu. A. (1980). On the inequality of individuals in plant populations. *Botanical Journal* **65**(3): 311-322.
- (xii). Zlobin, Yu. A. (1980). Cenopopulation diagnostics of the ecotope. *Ecology* **2**: 22-30 (Russian).
- (xiii). Zlobin, Yu. A. (1981). On the levels of plant viability. *Journal of General Biology* **62**(4): 492-505 (Russian).
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#### **2.4. Erast Anatoliyovich Golovko (1937-2005)**

Well-known plant physiologist and soil microbiologist, doctor of biological sciences, professor.

**Early life and education:** E.A. Golovko was born on May 9, 1937 in Bila Tserkva, Kyiv region. In 1961 he graduated from the Bila Tserkva Agricultural Institute with a degree in agronomy and qualified as an agronomist. For three years, the future scientist held the position of Deputy Chief Agronomist of the Shramkiv Sugar Plant of the Cherkasy Sugar Bury Trust (Shramkovo, Drabiv District, Cherkasy Region).

**Professional life and contributions to allelopathy:** (formed on the basis of the publication 44,49,59,60). In 1963-1966 he studied at the graduate school of the Polar-Alpine Botanical Garden of the Kola branch of the USSR Academy of Sciences (Kirovsk, Murmansk region), majoring in microbiology, after which he worked as a junior researcher in the laboratory of microbiology and soil science of the same institution. In 1969, under the guidance of Professor MB Roizin at the Leningrad Agricultural Institute, he defended his dissertation on 'Activation of biological processes in peat soils of the Kola Peninsula as a basis for increasing their fertility' and received the degree of candidate of agricultural sciences in 'soil microbiology' and graduated in 1972. In the Polar-Alpine Botanical Garden of the Kola Branch of the USSR Academy of Sciences, the scientist studied the microflora and enzymatic activity and the influence of higher plant growing conditions on soil biological activity, the role of microorganisms in the transformation of plant residues and humus substances in peat soils. The features of microbiological activity depending on genesis, cultivation and nitrogen regime of soils were revealed.

In 1970-1973, the scientist studied the role of thionic bacteria in the leaching of poor sulfide copper-nickel ores.



Figure 5. Doctor of Agricultural Sciences Erast Anatoliyovych Golovko.

Since 1973, the scientific activity of E.A. Golovko continued in Ukraine. For some time (1973-1974) he worked as a junior researcher at the Institute of Alcohol Industry, and from 1974 until the last days of his life - in the Central Republican Botanical Garden of the USSR Academy of Sciences (now the National Botanical Garden named after MM Grishko NAS of Ukraine). Here he was a junior researcher in the Allelopathy Laboratory of the Department of Plant Physiology (headed a group of microbiologists), a senior researcher, and from 1978 to 2005 – Head of the Department of Plant Physiology, which was later renamed the Department of Allelopathy. In 1982 he was awarded the title of senior researcher in ‘microbiology’.

E.A. Golovko studied the role of ecologically closed ecosystems of different levels (artificial - botanical gardens, arboretums and natural - reserves, sanctuaries) and soil microorganisms in the allelopathy of higher plants and on this basis developed effective measures to preserve soil fertility conditions of chernozem soils at different levels and crops in typical crop rotations (21-28). On the basis of generalization of own researches the review article ‘Allelopathy of plants: history, theory and priorities’ was prepared (16,18,19). Scientists for the first time generalized results of researches of mechanisms of interaction of organisms in biogeocenoses, considered in detail soil in intensive agrophytocenoses and formulated the concept of role (15,26). The scientist effectively studied allelopathic soil tillage under different variants of monoculture of basic agricultural plants and on the basis of this design of reliable and highly productive agrophytosystems with minimal harmful effects on the soil. He also elaborated on the rational schemes of crop rotation (including a number of vegetable and aromatic plants), the level of soil microbiological activity in different crop rotation schemes, allelopathic approaches to soil cultivation and the use of soil as an artificial substrate in different peat. Based on this, the author found that one of the factors of allelopathic soil fatigue is the accumulation in the soil of phytotoxic compounds that come with root secretions, leached from post-harvest residues and formed by phytotoxic species of microorganisms. Scientists have also proven the importance of microscopic fungi in the formation of phytotoxic substances that accumulate in the soil and adversely affect plant life (15).

Under the guidance and with the direct participation of Erast Anatoliyovych, new knowledge was gained about the total number and soil composition of the microflora of field crops. He identified phytotoxic species and analyzed the taxonomic structure of microbiocenoses of the rhizosphere of steppe plants, followed by identification of the species composition of microorganisms, which allowed to create a gene bank of biologically active species (over 500 strains). The allelopathic activity of 27 species of dominant plants of steppe vegetation of nature reserves of Ukraine was also determined (26).

Scientists have developed effective methods for identifying phytogenic volatile secretions of plants (especially a number of valuable introducers), proposed methods for studying the interaction and determining the concentration of volatile secretions in a closed volume (greenhouses, phytotrons, laboratories) and creating natural physiological phyto regulators and herbicide compounds, action to control the number of segetal plant species. The scientist and their students conducted physiological research related to allelopathic activity of plants - the selection and identification of physiologically active substances that simulate the soluble and absorbing activity of root systems, test systems of plants and microorganisms (17).

Table 5. Chronology of main events

Dates	Events
1937	Born on May 9, 1937 in Bila Tserkva, Kyiv region (Ukraine)
1944-1955	Schooling
1956-1961	Studied at the Bila Tserkva Agricultural Institute
1961-1963	Deputy Chief Agronomist of Shramkivsky Sugar Plant of Cherkasy Sugarbury Trust
1963-1966	He studied at the graduate school of the Polar-Alpine Botanical Garden of the Kola branch of the USSR Academy of Sciences (Kirovsk, Murmansk region), majoring in 'microbiology'
1969	Defense of the candidate's dissertation 'Activation of biological processes in peat soils of the Kola Peninsula as a basis of increase of their fertility' (specialty soil microbiology)
1972	He graduated from the Higher Courses in Patent Science and Invention
1970-1973	Investigation of the role of thionic bacteria in the leaching of poor sulfide copper-nickel ores
1973-1974	Junior researcher at the Ukrainian Research Institute of Alcohol Industry
1974-1978	Junior and senior researcher of the laboratory of allelopathy of the Department of Plant Physiology of the Central Republican Botanical Garden of the USSR Academy of Sciences
1982	Senior Researcher in Microbiology
1985	Defense of the doctoral dissertation 'Physiological and biochemical bases of interaction of higher plants and microorganisms in natural and artificial ecosystems' (scientific degree of Doctor of Biological Sciences in two specialties 'plant physiology' and 'microbiology')
1995	Academic title of Professor of Plant Physiology
1978-2005	Head, Department of Plant Physiology (later renamed the Department of Allelopathy)
2005	Expired on 13 December, 2005

The scientist's research interests also included the study of the function of phenolic compounds in the allelopathy of higher plants and microorganisms, the mechanisms of its interaction, the search for donor plants of physiologically active substances as alternative agrochemicals and other highly effective substances of natural origin.

For many years he was a member of specialized scientific councils for the defense of doctoral (candidate) dissertations at the Institute of Plant Physiology and Genetics of NAS of Ukraine, Institute of Agroecology and Biotechnology UAAS, National Botanical Garden of NAS of Ukraine, Deputy Academician-Secretary of the Department of General Biology, member of the Presidium Council and chairman of the section 'Plant Nutrition Physiology' of the Ukrainian Society of Plant Physiologists, member of the Society of Microbiologists of Ukraine, Council of Botanical Gardens and Arboretums of Ukraine, editorial boards of journals 'Physiology and Biochemistry of Cultivated Plants', 'Bulletin of Kharkiv National Agrarian University', Secretary of the Biology Section of the Committee for State Prizes of Ukraine in the field of science and technology, a member of the International Allelopathic Association, Chairman of the Committee for the Award of the International Prize A.M. Grodzinsky for the best monograph on allelopathy.

The scientist was a participant in many international conferences on allelopathy during 1994-2004, worked closely with scientists in the United States, the Czech Republic, Slovakia, India, Poland and others.

Professor E.A. Golovko died 13 December, 2005.

**PUBLICATIONS:** The scientist has independently and co-authored almost 200 scientific papers, including 7 monographs and a textbook. For the monograph 'Microorganisms in the allelopathy of higher plants' E.A. Golovko had awarded the Prize of M.G. Kholodny of the Academy of Sciences of Ukraine.

#### **Books/Monographs**

- (i). Golovko, E.A. (1984). *Microorganisms in the Allelopathy of Higher Plants*. 207 pp. K.: Naukova Dumka (Russian).
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- (v). Grodzinsky, A.M., Golovko, E.A., Bezmenov, A.Ya. (1992). *Interaction of Volatile Emissions in Closed Ecosystem*. 127 pp. Kiev: Naukova Dumka (Russian).

### Research Papers

- (i). Boyko, P.I. and Golovko, E.A. (1983). Features of microbial communities in the rhizosphere of permanent crops of field crops of the Forest-steppe of the Ukrainian SSR. In: *The Role of Plant Toxins in Allelopathy* pp. 30-41. K.: Naukova Dumka (Russian).
- (ii). Bukolova, T.P., Golovko, E.A. and Grodzinsky, A.M. (1978). Study of indirect allelopathy: Dynamics of epiphytic microflora and composition of copper dew in Caucasian and small-leaved limes. In: *Allelopathy Problems*. pp. 135-145. K.: Naukova Dumka (Russian).
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- (v). Golovko, E.A. (1974). The influence of higher plants on the biological activity of peat soil. In: *Biological Processes and Mineral Metabolism in the Soils of the Kola Peninsula. Collection of Scientific Papers* pp. 70-93 (Russian).
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- (vii). Golovko, E.A. (1985). Physiological and biochemical foundations of the interaction of higher plants and microorganisms in natural and artificial ecosystems: *Abstract, Dissertation (Doctor of Biological Sciences)*. 35 pp. K.: Institute of Plant Physiology of the Academy of Sciences of the URSR (Russian).
- (viii). Golovko, E.A. (1989). Allelopathy of the plants: history, theory, priority. *Bulletin of the Academy of Sciences of the URSR* **8**: 38-46 (Ukrainian).
- (ix). Golovko, E.A. (1990). Hans Molisch and modern allelopathy. In: *Allelopathy and Plant Productivity. Collection of Scientific Papers* pp. 14-23. K.: Naukova Dumka (Russian).
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### 2.5. Larisa Dem'yanivna Yurchak (1937-2010).

Microbiologist, plant physiologist, doctor of agricultural sciences, one of the representatives of the world-renowned scientific school of Academician of the USSR Academy of Sciences Andriy Grodzinsky, allelopathic scientist.

**Early life and education:** Yurchak Larysa Demyanivna was born on August 23, 1937 in Kansk, Krasnoyarsk Krai (Russia) in the family of a teacher of agricultural technical school. In the school years 1944-1955, the future scientist showed a flair for the biological sciences.

In 1955-1960 she studied at the Shevchenko' Kyiv State University at the Faculty of Biology. After graduation, she was sent to the position of senior laboratory assistant at the Institute of Botany of the USSR Academy of Sciences in the Department of Plant Physiology, where a group of allelopathy was formed under the leadership of senior researcher A.M. Grodzinsky at the Institute of Botany (81).



Figure 6. Larysa Demyanivna Yurchak.

**Professional life and contributions to allelopathy:** (formed on the basis of publications 75,77,79-84). In 1962, the results of research obtained using the developed biological method for determining the activity of phytotoxic substances using germinated seeds were first published. The experimental microbiological part of this work was performed by a young specialist L.D. Yurchak of the Institute. Her improved method for studying phytotoxic water-soluble and volatile substances of seeds, fruit shells, leaves and roots of plants, dead litter, root secretions, etc. allowed to obtain quite reliable results. She took an active part in field expeditions organized by A.M. Grodzinsky in 1961-1965 for the accumulation and careful study of new material on the allelopathic properties of plants of different types of phytocenosis.

During 1967-1971 she worked as a junior researcher in the Department of Ecology and Plant Physiology (since 1983 - Department of Allelopathy) in the Central Republican Botanical Garden of the USSR Academy of Sciences where she studied the role of microorganisms in the interspecific relationships of phytocenosis. The object of the first research was sidereal lupine, during which special attention was paid to the accompanying soil microflora.

Table 6. Chronology of main events

Dates	Events
1937	Born on August 23, 1937 in the city of Kansk, Krasnoyarsk Krai (Russian Federation)
1944-1955	Schooling
1955-1960	Studying at Shevchenko' Kyiv State University named at the Faculty of Biology
1961-1965	Participation in field expeditions organized by A.M. Grodzinsky
1967-1971	Junior researcher of the Department of Ecology and Plant Physiology (since 1983 - Department of Allelopathy) of the Central Republican Botanical Garden of the USSR Academy of Sciences
1971	Defense of the candidate's dissertation 'Physiologically active substances of green lupine and accompanying microflora' at the Institute of Botany of the USSR Academy of Sciences
1971-1975	Study of allelopathic features of green crops
1976-1980	Investigation of allelopathic properties of plants in different types of phytocenosis
1986-1990	Execution of complex scientific work on research of allelopathic properties of aromatic plants of polyfunctional value and accompanying soil microflora
1996-2005	Study of allelopathic aspects of agrophytocenoses of aromatic plants
2002	Defense of the doctoral dissertation 'Ecological bases of allelopathic interaction and aftereffects of aromatic plants in agrophytocenoses'
2005	Publication of the monograph 'Allelopathy in agrobiogeocenoses of aromatic plants'
2003-2010	In-depth study of allelopathic properties of aromatic plants
2010	Expired on 29 August, 2005

The result of scientific research of the scientist was the candidate's dissertation 'Physiologically active substances of sidereal lupine and accompanying microflora' in 1971 at the Institute of Botany of the USSR Academy of Sciences. After her defense in 1971-1975, she continued to study the sidereal properties of lupine: she studied the issues of allelopathically active compounds of aqueous extracts and volatile substances formed during the decomposition of lupine, and in more detail the effect of active metabolites of microorganisms on its decay.

During 1976-1980, the scientist studied the allelopathic properties of plants in different types of phytocenosis, the role of microorganisms in the formation of soil tillage under crops and fodder crops, as well as the system of tillage and fertilizer use, finding out the allelopathic role of plant secretions in strengthening or, on the contrary, reducing the toxicity of the soil, studied the microflora and allelopathic features of forage plants of the cruciferous family. Since 1980, the scientist has studied the allelopathic activity of flower and fruit crops. Investigating allelopathic processes under flowering plants, she concluded that the

indirect effect of specific microflora on the chemical relationships of plants in phytocenosis. It establishes the toxic properties of many ornamental and flowering plants that are widely cultivated in Ukraine for various purposes. The scientist detailed the phenomenon of soil erosion under fruit trees (apple, pear, apricot). It is noted (83,84), the author found that many species of bacilli are absolute antagonists against other groups of soil microflora. Due to this property, they can gain a predominant place in the microbiocenosis. In addition, the shells of spore-forming microorganisms, due to resistance to various extreme conditions (insolation, radiation, salinity, etc.), have high adaptive properties. Because southern soils are constantly exposed to high temperatures, they have a high biogenicity of bacillary flora. Trees of different apple varieties emit a significant amount of phenolic substances into the soil and, as a result, under fruit trees in the sphere of influence of the root system a specific biochemical environment is formed, which determines the structure of the microbiocenosis. During 1980-2005, the scientist focused on the study of allelopathic and phytoncide properties of introduced aromatic plants cultivated in Ukraine.

In 1986-1990, Yurchak performed complex scientific work on the study of allelopathic properties of aromatic plants of multifunctional significance and related soil microflora, phytoncide activity of medicinal and essential oil crops, as well as biological activity of essential oils and their components. She isolated and identified bacteria, fungi, actinomycetes, spore-forming microorganisms, as well as studied the phytotoxic properties of soil microorganisms (Figure 7).

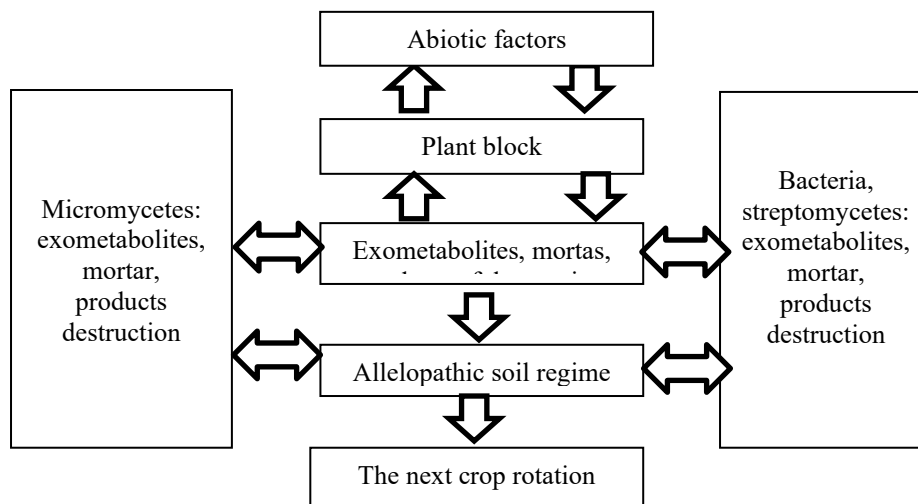


Figure 7. Scheme of formation of allelopathic soil regime in agroecosystem (according to Yurchak (346)).

During 1996-2005, Yurchak focused on the study of allelopathy in agrobiogeocenoses of aromatic plants in the ecological aspect, studied the allelopathic features of the leading ether carriers during ontogenesis and the influence of ecological conditions on their manifestation. She revealed the role of physiologically active substances of aromatic plants and the accompanying microbial coenosis in the formation of the phenomenon of soil fatigue (79,80,83).

The scientist modernized approaches to planning and development of crop cultivation technology by introducing as mandatory elements such items as selection of the variety with the lowest autointolerant properties, place in crop rotation depending on allelopathic influence of previous and subsequent crops in agrophytocenosis, allelopathic assessment after requirements to the feeding area taking into account allelopathic features, to different doses of mineral fertilizers, etc.

In 2002, summarizing his many years of experience Yurchak successfully defended her doctoral dissertation 'Ecological bases of allelopathic interaction and aftereffects of aromatic plants in agrophytocenoses'.

In the period 2003-2010, the scientist focused on in-depth study of aromatic plants: the disclosure of the chemical nature of a number of colins during the growing season of sage, peppermint, lavender, marigolds; allelopathic, biochemical and microbiological indicators, she established the ability to use plants of the genus *Calendula* as green manures. The scientist is an active participant in activities of various levels on allelopathy. After the death of Academician A.M. Grodzinsky and Professor E.A. Golovko, headed the annual event - 'Day of Allelopathy' (October 15), which involved most regions of Ukraine.

In 2005, in his monograph 'Allelopathy in agrobiogeocenoses of aromatic plants', the latest achievements in the field of allelopathy in Ukraine were summarized. Theoretical issues and practical developments in the field of allelopathic interaction and aftereffects of aromatic plants in agroecosystems for their cultivation in terms of crop rotation, monoculture and compatible crops are considered.

According to the results of their own comprehensive research of aromatic plants L.D. Yurchak revealed the importance of their interaction in the occurrence of the phenomenon of soil fatigue and developed a scheme for the formation of allelopathic soil regime. In this way, she proved that the allelopathic soil regime is formed under the influence of plant and microorganism products (79,80,83).

Scientist actively studied the allelopathic interaction of different types of crops from the standpoint of crop rotation (50), the typology of their root nutrition, overall bioproductivity, the rate of decomposition of their residues in the soil. It expands the typology of phytocenoses from the standpoint of their allelopathic relationships. The scientist also studied greening as a format of alternative organic fertilizer from the standpoint of allelopathic influence on subsequent crops, the duration of decomposition of the latter and the general chemistry of this process, including the influence of substances formed during decomposition on the soil-plant-environment system (Figure 7). She researched the

accompanying microflora of the process of decomposition and mineralization of plant residues (straw, stems, root systems, etc.), as well as the effectiveness of such decomposition by the nature of substances formed, including the study of metabolites of soil saprophytic bends. In fact, in the former Soviet Union, it laid down practical approaches to organic and organic farming in terms of the use of organo-green manure systems and the basic principles of preliminary allelopathic assessment.

The scientist was also a member of the editorial board of 'Agroecological Journal' and 'Introduction of Plants', published by the Institute of Agroecology and Biotechnology UAAS and National Botanical Garden NAS of Ukraine.

She died on August 29, 2010 after a serious illness.

**Publications:** The scientist has published more than 220 scientific papers and 3 monographs.

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### 3. CONCLUSIONS

USSR Prominent Allelopathy Scientists of the period 1926-2010, based on a scrupulous detailing and analysis of predecessors, formed a scientific concept of allelopathy with the formation and detailing of its components such as donor-acceptor interaction of plants in the system of competitive relationships, formation of a system of aboveground and rhizosphere interactions of plant species in the system of biocenoses of different complexity of construction, development cycle and life expectancy, biochemical portfolio of the main parts of plants for a particular species. On this basis, theories of soil fatigue and soil depletion, allelopathic aftereffect and inhibition were developed with the possibility of using these processes in a rational system of organizing crop rotations of different rotations, selecting predecessors, forming prerequisites for biological protection systems, phytoergonomics and landscape phytodesign. The phytoncidal systems of plant interaction were detailed and their practical application in various areas of anthropogenic activity was developed. The allelopathic activity of a number of tree, shrub, aromatic, and medicinal plant species was studied, and practical aspects of allelopathy application in plant protection planning, cultivation technologies, medicine, soil science, and biogeocenology were developed. The generalization of these results allowed scientists of this period to form the world-famous theory of cenopopulation vitality and to develop an algorithm for analyzing the life strategies of individual species in populations of varying design complexity and the possibility of a

detailed prognostic analysis of the prevalence and survival of a species, and the formation of its bioproductivity. This became the basis for a population-based approach to planning plant density, selecting species for varietal and species blends, predicting plant architectonics and the feasibility of growing under these parameters to create a cenosis. This period is noted as the most active in the development of allopathic research in the former USSR, often called the Grodzinsky period in honor of the founder and founder of the allopathic school.

### **DECLARATION OF COMPETING INTERESTS**

The authors declare that they have no competing financial interests related to the publication of this manuscript. The research was conducted independently, free from any conflicts of interest that could have biased the findings.

### **AUTHORS' CONTRIBUTIONS**

Both authors approved and finally draft of manuscript.

### **CONFLICT OF INTEREST**

The authors declare no conflict of interest. All authors agree to publish it.

### **ETHICAL STATEMENT**

This is to inform you that in this study, we have not been involved in any animal and human studies.

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