MENDEL UNIVERSITY IN BRNO
Faculty of Horticulture, Lednice
Department of Breeding and Propagation of Horticultural Plants

Mendel, Vavilov and Brno

Petr Salaš, Ladislav Rygl, Miroslav Sedláček, Jan Lužný

2016

Gregor Johan Mendel
(1822–1884)

Nikolai Ivanovich Vavilov
(1887–1943)

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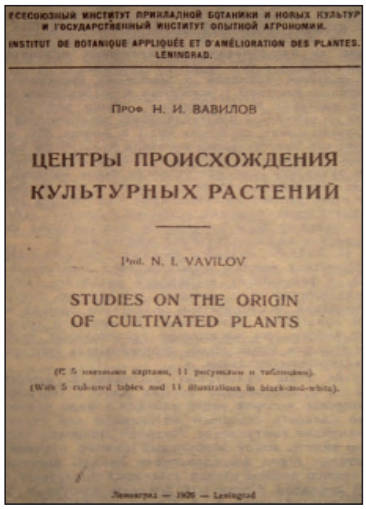
Nikolai Ivanovich Vavilov

Nikolai Ivanovich Vavilov (1887–1943), world-famous excellent Russian researcher, scientist, geneticist, plant cultivator and botanist has gained immortality in the history of cultivation and genetics of agricultural crops. He was many years' representative of Russian (later of Soviet) botanical, genetic and agricultural science. Its greatest contribution was defining of so-called gene centres of cultural plants, i.e. delimitation of origin of plant species. He has also defined the primary and secondary gene centres.

Hereby Vavilov has given an impulse for founding of collections of species and varieties which may be utilized for cultivation of cultural plants according to the situation and needs. On this principle today the so-called gene banks are founded which serve not only for preservation of plant species but also like a source of initial material to various breeding purposes.

Map of gene centres according to N. I. Vavilov (archive of authors)

Vavilov has formulated also the law of homological orders of heritable variability thus it is possible to deduce the occurrence of some attributes within the framework of relatives. He had informed the public about the results of his experimental work already in year of 1926. In its time the publication on gene centres together with the law of homological orders were an important and original information that has brought to him not only world recognition but many appreciations later. It is possible to compare the law of homological orders of heritable variability to a certain extent with Mendeleev's periodic law (Dmitri Ivanovich Mendeleev, 1834–1907).


ВСЕСОЮЗНЫЙ ИНСТИТУТ ПРИКЛАДНОЙ БОТАНИКИ И НОВЫХ КУЛЬТУР
И ГОСУДАРСТВЕННЫЙ ИНСТИТУТ ОПЫТНОЙ АГРОНОМИИ.
INSTITUT DE BOTANIQUE APPLIQUÉE ET D'AMÉLIORATION DES PLANTES.
LENINGRAD.

Проф. Н. И. ВАВИЛОВ

ЦЕНТРЫ ПРОИСХОЖДЕНИЯ КУЛЬТУРНЫХ РАСТЕНИЙ

Prof. N. I. VAVILOV

STUDIES ON THE ORIGIN OF CULTIVATED PLANTS

Centres of origin of cultivated plants, 1926 (archive of authors)

The homological order consists of a group of related plant species that have similar, thus homological signs and attributes. This is caused by genetics as well as by the influence of long-term development in certain environment. The plants can resemble by content of certain substance, by way of pollination, reproduction, by certain types of resistance or by mutation. From this knowledge about homological orders we can conclude of occurrence of certain attributes within the framework of wider circle of genera and so to make the search for suitable genetic sources for breeding, easier.

Brno – air shot onto historical part *(photo L. Rygl)*

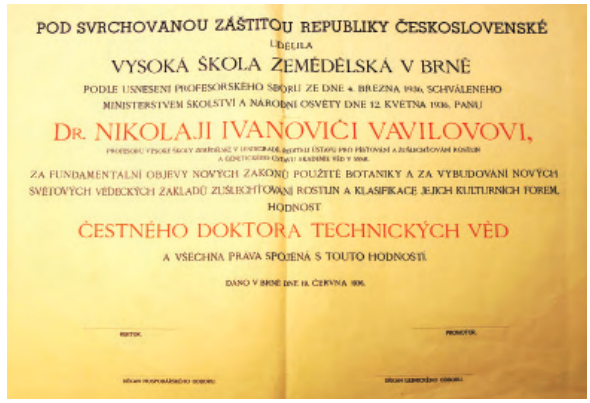
What relation had actually N. I. Vavilov to former Czechoslovak Republic, to Brno, to J. G. Mendel and to Agricultural University in Brno? It was an indirect but close and personal relation. Nikolai Ivanovich Vavilov has acknowledged Johann Gregor Mendel (1822–1884) as a founder of modern genetics. He has expressed himself already in year of 1935 to Mendel's work and his working results in his „Experiments with plant hybrids" publication this way: „The Mendel's theory and its further development represents one of the most splendid chapters of contemporary biology". Very interesting is the fact that already in year of 1929 Professor N. I. Vavilov was nominated and approved to be a corresponding member of ČSAZ (Czechoslovak Agricultural Academy) in Prague. In 1931 he became a regular foreign member of this academy as an expression of respect to his scientific work.

J. G. Mendel in time of his trials

Mendel's glasses and microscope (Moravian museum in Brno)

Historically the name of Professor Vavilov is connected with Brno although he had never visited this town. He was about to go there – and not for any visit. Rector of the Agricultural University Prof. Dr. Ing. Alois Tichý and the deans – Prof. Dr. Ing. František Chmelař and Prof. Ing. Antonín Dyk – have awarded a degree to Nikolai Ivanovich Vavilov together with Erich Tschermak von Seysenegg from the Vienna College and Ernst Laur, Professor of Zürich College of doctors in honour (Dr.h.c.) in auditorium of University of Agriculture in Brno (today Mendel University Brno – MENDELU) on June 19, 1936. Unfortunately Vavilov was not present in person but he has sent a ceremonial paper and letter of this wording: **"A disease has hindered me in fulfilling my fervent wish to visit Brno, the home of modern genetics".**

Lets' highlight from the text of his lecture which was presented on his behalf by the dean Prof. Dr. Ing. František Chmelař:
"In the scientific questions does not exist a crisis. On the contrary, the scientific problems emerge every day and it is necessary to solve them from the theoretic as well practical point of view. These problems are inexhaustible and they may be solved only by an international scientific cooperation".


POD SVRCHOVANOU ZÁŠTITOU REPUBLIKY ČESKOSLOVENSKÉ
UDĚLILA
VYSOKÁ ŠKOLA ZEMĚDĚLSKÁ V BRNĚ
PODLE USNESENÍ PROFESORSKÉHO SBORU ZE DNE 4. BŘEZNA 1936, SCHVÁLENÉHO
MINISTERSTVEM ŠKOLSTVÍ A NÁRODNÍ OSVĚTY DNE 12. KVĚTNA 1936, PANU
Dr. NIKOLAJI IVANOVIČI VAVILOVOVI,
PROFESORU VYSOKÉ ŠKOLY ZEMĚDĚLSKÉ V LENINGRADĚ, ŘEDITELI ÚSTAVU PRO PĚSTOVÁNÍ A ZUŠLECHŤOVÁNÍ ROSTLIN
A GENETICKÉHO ÚSTAVU AKADEMIE VĚD V MOSKVĚ
ZA FUNDAMENTÁLNÍ OBJEVY NOVÝCH ZÁKONŮ POUŽITÉ BOTANIKY A ZA VYBUDOVÁNÍ NOVÝCH
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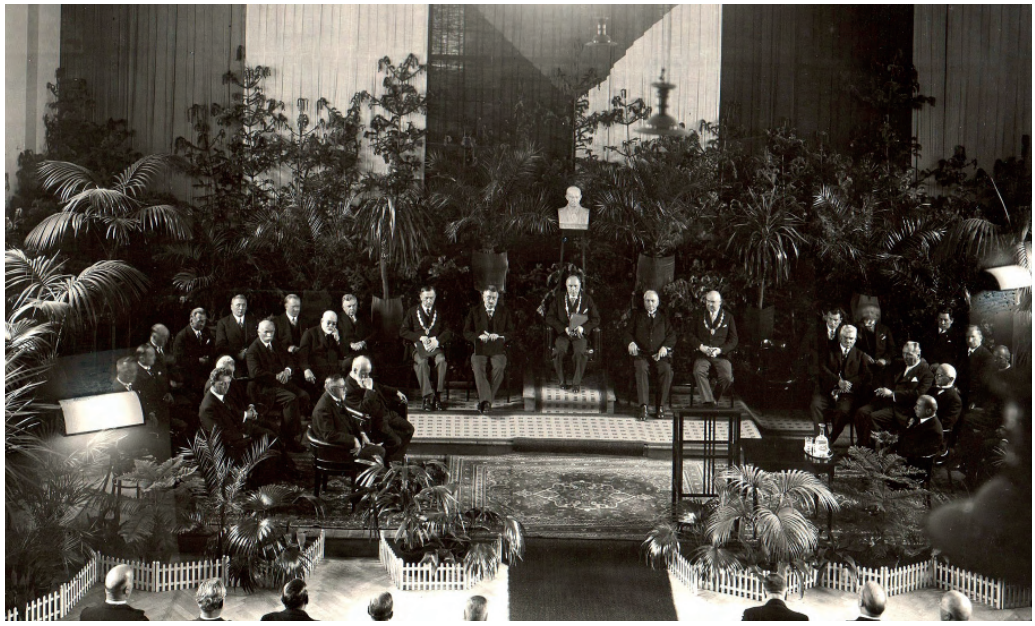
A VŠECHNA PRÁVA SPOJENÁ S TOUTO HODNOSTÍ.
DÁNO V BRNĚ DNE 19. ČERVNA 1936.
REKTOR
PROMOTOR
DĚKAN HOSPODÁŘSKÉHO ODBORU
DĚKAN LESNICKÉHO ODBORU

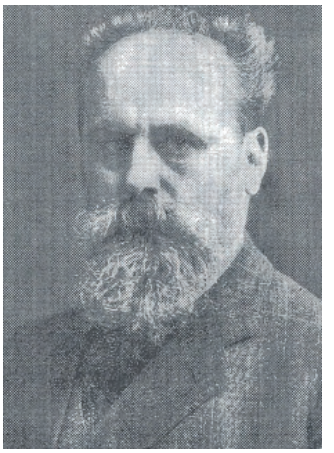
Degree of N. I. Vavilov, 1936 *(archive of MENDELU)*



Ceremonial graduation, Brno, 19. 6. 1936 *(archive of MENDELU)*

Prof. Erich Tschermak von Seysenegg

Prof. Nikolai Ivanovich Vavilov



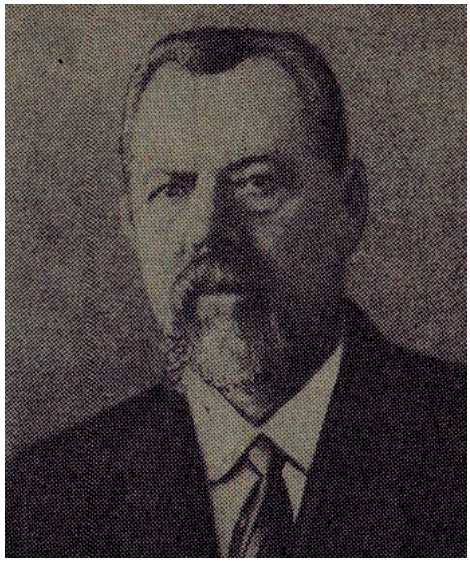
Prof. Ernest Laur (archive of MENDELU)

The honorary doctorate of Brno was the first award of its kind given to Vavilov abroad. Just in Brno where in 1865 the abbot of Augustinian monastery, botanic explorer and scientist, professor at high school Johann Gregor Mendel has formulated the results of his trials, in which he had explained the laws of heredity which have lead by further experiments and researches later into establishment of relevant scientific discipline – genetics which is an indispensable part of study of the plant and animal kingdom today.

Augustinian monastery and Basilica of Assumption of the Virgin Mary in Old Brno (photo L. Rygl)

Mendelianum Brno – Mendel's small experimental garden, historical undated shot (photo of Moravian Museum in Brno)

The family of Vavilov has come from Ivashkovo village in Volokolamsk domain in Moscow region (Russia). Originally they have been farmers who also traded with lax. The parents of Nikolai Ivanovich have moved in half of 19th century to Moscow. Nikolaj Ivanovich was born according to Orthodox calendar on November 13 (that is November 26 according to contemporary calendar) in year of 1887. The name of his father was Ivan Ilyich Vavilov and he was born in 1863. In 1884 he has married Alexandra Mikhailovna – who was five years younger. They had seven children together, from which only four children have stayed alive. All children have acquired upper education.

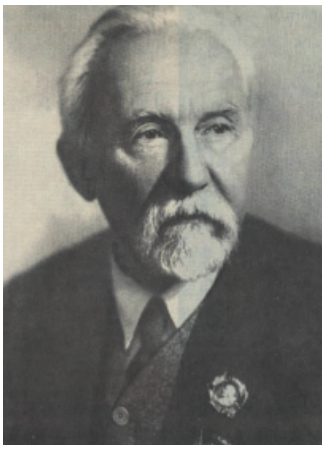


Ivan Ilyich Vavilov, farther (archive of authors)

The young Nikolai was very gifted, diligent pupil and student. After the basic and secondary education he has begun to study at the then Moscow Agricultural College (today Russian State Agrarian University-Moscow Timiryazev Agricultural Academy) in 1906. He has finished his studies in 1910. Professor Dmitry Nikolayevich Prjanishnikov had accepted him as assistant. Simultaneously he was in contact with Professor of plant breeding D. L. Rudzinski, which was the head of the Moscow plant breeding station. He has gained popularity and he was picked as a perspective pedagogical worker. Therefore he was delegated already in 1913 for study stay in England, France and Germany.

Nikolai Vavilov with mother a brother Sergey, 1916 (archive of authors)

Russian State Agricultural University of K. A. Timiryazev, Faculty of gardening and garden architecture, Moscow (photo S. V. Akimova, 2013)



Professor D. N. Prjanishnikov (archive of authors)

Professor D. L. Rudzinski (archive of authors)

Expedition to Mexico and Central America, 1930

Azerbaijan, at Diospyros kaki plant, 1936

N. I. Vavilov in Bolivia, 1932 (all from archive of VIR St. Petersburg)

Vavilov was greatly interested in the geographic expeditions and not only in those into the areas of the former Soviet Union but into further continents, too. Already in 1916 he has organized and carried out an expedition to Persia (today's Iran) and into area of Pamir. In 1924–1927 he has visited the areas in surroundings of Mediterranean Sea, North Africa, Ethiopia, Eritrea, Yemen and so on. He has gained precious knowledge and also numerous collections from these journeys. In 1930 he took part in a significant expedition to the areas of Central America and Mexico. In the course of further years his co-workers and followers has led the expeditions. After an expedition to Afghanistan in 1920 N. I. Vavilov has obtained a medal of Nikolai Mikhaylovich Przhevalski (1839–1888) for significant contribution to geographical sciences from the Geographical Society of the USSR. (M.N. Przewalski was famous Russian geographer and expert for the Central and East Asia.)

Monument of M. N. Przhevalski, Karakol, Kyrgyzstan (photo P. Salaš)

From expedition of N. I. Vavilov to Iran (archive of authors)

Caucasus expedition – N. I. Vavilov in Sukhumi (archive of authors)

N. I. Vavilov in France, 1931
(archive of VIR St. Petersburg)

The thirties were very prolific for Vavilov. He directed the All-Union Association of Production and he was already worldwide regarded specialist. He was almost a regular participant of genetic and cultivation conferences. In 1925 at the first enlarged session of the Institute of Botany and New Varieties on plant (Institut prikladnoj botaniki i novych kultur) he has lectured on plant wealth of the Earth and on the possibilities of its utilization. In 1926 he received high state award for published works. In 1927 at the International Genetic Congress in Berlin he held an overall lecture on gene centres of cultivated plants (O mirovych centrach genov kulturnych rastenij).

In the same year he could present a paper already at the conference of agricultural experts in Roma On current results of geographical trials in the USSR (O predvaritelých rezultatach geografičeskich opytov SSSR). In 1929 he was appointed a member of commission for implementation of botanical expeditions at the Academy of Sciences of the USSR. In 1930 he took part at the IX International Gardening Congress in London with a lecture on the Botanical Species of Fruit Crops in Asian areas of the USSR and Caucasus. Actively he has appeared also at the International Botanical Congress in Cambridge where he has talked on the Linné botanical systems. In the same year he was invited to the International Conference of Agricultural Economy which took place in town of Ithaca (USA, State of New York).

N. I. Vavilov at the International Congress of Geneticists in Berlin, 1927
(archive of VIR St. Petersburg)

N. I. Vavilov with participants of agricultural congress in America, 1921 (archive of authors)

Vavilov has dedicated also a great care and attention to experimental stations focusing on the plants collections in many locations and areas of the then USSR. The All-Union Institute of Plant Production (today it is VIR) in the former Leningrad (Sankt Peterburg) was a central workplace that has processed the message segments (partial reports).

Building of VIR, St. Petersburg *(photo K. Tkachenko, 2011)*

Vavilov has dedicated an extraordinary attention to the development and spreading of growing subtropical plants in various areas of the USSR. Not only at the sessions but also in specialized broadcasting programmes he has focused on the subtropical plants which were possible to grow in the USSR. At the beginning of the thirties the subtropical plants were widened on about 1,500 hectares. Thanks to Vavilov's researches they were grown already on 50, 000 ha in 1940. The biggest increase was especially in Sokhumi and Batumi areas. Besides Vavilov the workers of the Sokhumi and Batumi botanical gardens had a merit on that.

Kyrgyzstan – offer of fresh also dried subtropical fruit in market place in Bishkek *(photo P. Salaš, 2008)*

Lupinus vavilovii *(photo L. Rygl)*

Avena vaviloviane *(photo L. Rygl)*

Secale cereale ssp. Vavilovii *(photo L. Rygl)*

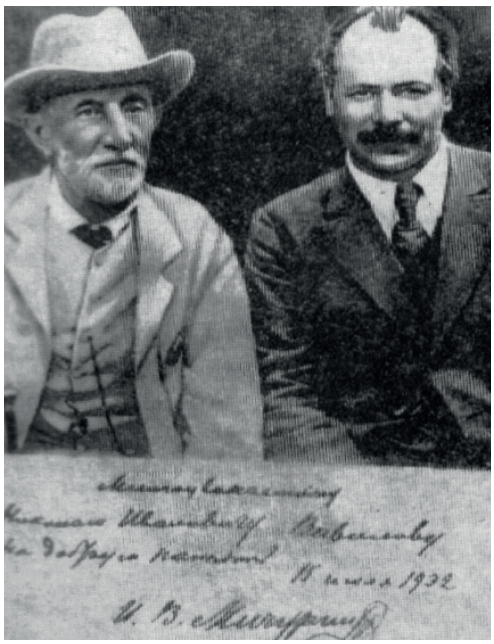
Secale cereale ssp. vavilovii var. Afghanicum *(photo L. Rygl)*

In spite of the fact that the Vavilov's researches were dedicated to broad circle of cultivated plants, the cereals stayed in the foreground. They have become fatal to him in some way. In the years of strong pressure of Stalinism, leading to creation of common agricultural cooperatives (kolkhozes) or to building of state farms (sovkhozes), the current way of production has changed. The politically installed members of management were lacking experience, the care was missing, it came to prosecution of farmers which did not have a trust to the newly being-introduced methods of cultivated plant growing. The yields were very low, and because the Stalin regime preferred the urban population, also these yields were driven from the rural area and they were placed at disposal to the towns. It has happened under pressure and by means of police and military bodies. The Soviet countryside was starving and the people were dying. In view of the fact that it came also to frequent freezing-out of cereals especially of wheat, the efforts to remove these shortages have appeared.

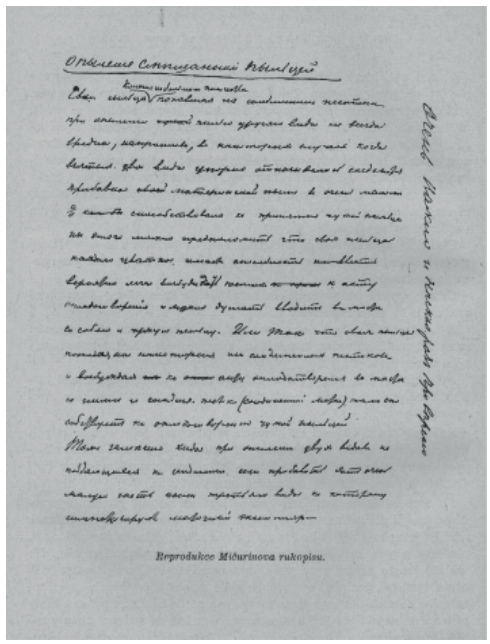
Ambitious and young researcher Trofim Denisovich Lysenko (1898–1976) longing for a successful career has begun to apply an own created theory (agrobiology). He pushed through his theories not by purely scientific verification but by political methods which should be salvation of economic results of agricultural production. The so-called lysenkism has arisen that besides other things has rejected Mendel's genetics and it has misused also the results of works of the grower and pomologist Ivan Vladimirovich Michurin. However, this experienced and meritorious practitioner had nothing in common with pseudoscientific opinions of Lysenko. The relation of N. I. Vavilov and I. V. Michurin was more than friendly on the contrary. Vavilov appreciated the Michurin's assiduous work, especially at implementation of distant crossing (distant hybridization).

Luther Burbank (1849–1926) in year of 1902 (Wikipedia)

When Michurin has celebrated his fiftieth birthday (in 1924) and sixtieth birthday (in 1934), Vavilov took part in his celebrations of birthday in person. Similarly, he accepted also grower methods and practises of American grower Martin Luther Burbank, like he accepted the Michurin's methods, too.



I. V. Michurin a N. I. Vavilov



Reprodukce Michurinova rukopisu.

Handwriting of I. V. Michurin (archive of authors)

J. V. Stalin, 1951 (archive of authors)

Stalin has sided with Lysenko's activities and he has denounced harshly Vavilov which had to Lysenko's activity justified reservations although he has supported him at the beginning. In 1934 Vavilov had proposed Lysenko even for corresponding member of the Academy of Sciences of the USSR. Stalin had behaved to Vavilov very repugnantly and at one such negotiation he had snapped at him directly in Kremlin but also he has accused him. To the contrary Stalin was very inclined towards Lysenko. Vavilov was termed as a brake of the scientific development and socialistic soviet agriculture.

In 1939 the N. I. Vavilov's journey through life has begun to change into a tragedy. In summer of that year he should take part at VII International Genetic Congress in Scotland (Edinburgh), however, the departure was not allowed to him. The crisis has begun on August 6, 1940 in time when Vavilov with his co-workers and students was in expedition in West Ukraine. In September 1940 he was imprisoned already in Moscow in department of NKVD (People's Commissariat for Internal Affairs) and he was designated as anti-Soviet saboteur. Vavilov has rejected strictly all false accusations which were brought a charge against him. His keeping in prison was cruel. He was not allowed to sleep, lay, he only was obliged to stand or to walk and several times a day he was interrogated.

Prison house building and cell of N. I. Vavilov in prison in Saratov (archive of VIR St. Petersburg)

He was sentenced to death by shooting on July 9, 1941 by military tribunal. The punishment was mitigated to him but he was relocated into prison in Saratov where they treated him very cruelly. The fact that in that time also his wife has lived in Saratov which did not know something of the fate of her husband, equally Vavilov did not know something of his spouse. The Saratov conditions were very cruel, as a consequence of this I. Vavilov has died on January 24, 1943. He was buried in communal grave in Saratov. Only in 1970 a monument was built over it.

Vavilov's monument in Saratov
(archive of VIR St. Petersburg)

Abroad there was nothing known about his fate in his last years. In 1942 he was appointed member of the British Royal Scientific Society in London. In 1945 when the American scientists have asked about him, nobody has answered them officially. N. I. Vavilov was rehabilitated after death of Stalin but only at the beginning of seventies of the past century the scientists in countries of the former Soviet bloc could stand up for his legacy fully and develop it in full-bodied way.

(archive of authors)

N. I. Vavilov, 1903

N. I. Vavilov, 1933
(archive of authors)

Contemporary successors

Many scientific institutions, departmental institutes, universities and also specialized breeding firms link up in the present day to the legacy and work of G. J. Mendel and N. I. Vavilov. The problems of biodiversity and gene sources is being solved at the national level (National Programme on Conservation and Utilization of Plant Genetic Resources and Agro-biodiversity of Ministry of Agriculture of the Czech Republic), as well within the framework of various international institutions (EU, United Nations, FAO) and agreements (Agenda 21, Agreement on Biological Diversity, Rio De Janeiro Declaration on Environment and Development, Framework Agreement of UNO on Climate Change and the like). **The Gene Bank of the Czech Republic** has its official headquarters within the framework of the **Crop Research Institute in Prag-Ruzyne** (Praha-Ruzyně), which is also a coordinator of National Programme on Conservation and Utilization of Plant Genetic Resources and Agro-biodiversity. A whole line of institutions, universities, breeders and also firms is hooked up into the programme. It is not possible to name all of them, therefore only some examples will be presented.

Buildings of IEB AS CR in Prag *(photo R. Černý, 2013)*

The Institute of Experimental Botany of the Academy of Sciences of the Czech Republic (IEB) in Prag performs mostly the basic research in plant biology, specifically in plant genetics, physiology, phytopathology and biotechnologies. It is active also in applied research. In plant genetics the projects are focused on molecular genetics of pollen and on functional genomics of plants. The physiological topics include the hormonal and ecological growth control and development of plants, transport mechanisms and effect of growth regulators, the physiology of plant viruses and the plant pathophysiology. In the field of biotechnologies the institute focuses, for example, on designing and preparation of edible vaccines from plants and of mechanisms of phytoremediation. Some projects are directing to practical applications. The study of plant hormones has led for example to a synthesis of substances which slow down the skin ageing or they show promising cytostatic effects. The IEB is also very successful in grafting of apple trees resistant against fungus diseases.

Modern workplace of **Institute of Experimental Botany of the Academy of Sciences of the Czech Republic** (IEB) in Olomouc-Holice is an example of scientific workplace with international meaning. A „Centre Region Hana for Biotechnological and Agricultural Research" was built-up within the framework of the common project of OP RDI, on which also the Palacky University in Olomouc and the Crop Research Institute take part. Top level-equipped workplace of IEB studies the structure and function of heritable information of plants. Acquired results clarify the changes of genome in the course of evolution and origin of species and they are also the base of utilization of new methods of breeding based on the methods of molecular biology and genomics. The workplace focuses itself on economically relevant plant species, especially cereals, fodder-growing grasses and also banana tree. The research team of IEB has elaborated a line of unique methods and it has achieved a line of world priorities in its field of activity.

Complex of IEB of AS CR in Olomouc-Holice
(photo E. Kejnovský, 2013)

Research and Breeding Institute of Pomology (RBIP) Holovousy is focused on research on fruit crops grown in the Czech Republic. It includes the broad problems from preservation of the gene pool, the research of grafting and seed grower problems, preservation of old varieties of domestic origin and study of all factors influencing the performance, quality and state of health of fruit crops. It implements a programme of new cultivation and of maintaining of selected species of fruit wood species.

Holovousy castle, old seat of RBIP Holovousy
(photo L. Laňar, 2013)

Faculty of Horticulture, Mendel University in Brno with its seat in Lednice prepares the specialists of various fields of horticulture and of garden architecture and landscaping already for more than 65 years. Many of its graduates have asserted themselves also in the field of breeding of various gardening crops, by courtesy of Professor Jan Lužný, the foundations of cultivation of gardening crops were laid. In the sixties of the past century he became first senior lecturer for discipline of breeding, multiplication and special genetics of gardening plants in the former Czechoslovak Republic and he has developed this field for more than 50 years. In the present day the Faculty of Horticulture is an integral part of system of preservation of genetic sources, the projects of the applied genetics field are implemented, a successful cultivation of selected gardening crops is under way. The Faculty possesses an extensive assortment collection for learning purposes and is also a member of the National Programme on Conservation and Utilization of Plant Genetic Resources and Agro-biodiversity, especially in the field of fruit species (apricot and peach trees, untraditional fruit species, grapevine), also has also the collections of medicinal, aromatic and seasoning plants of perennial vegetables and selected species of flowers.

Complex of Faculty of Horticulture *(photo L. Rygl, 2013)*

Research Institute for Fodder Crops, Troubsko is focused on applied research in the field of agriculture, environment and food processing industry. It deals with breeding, multiplication and sale of seed stocks. Within the framework of the National programme of conservation and utilization of gene pool of plants is specialized for the field of gene pool of forage species of plants, i.e. gathering, testing and description of fodder species. Farther the meadow and some threatened plants species are gathered. Available varieties, ecotypes and wild forms are valued.

Complex of Research Institute for Fodder Crops
(photo D. Knotová, 2013)

OSEVA PRO Ltd., Grassland Research Station in Zubří, which was founded in 1920, has originated as an expression of an effort to enhance the level of farming on meadows and pastures in Wallachia and it belongs to the oldest workplaces of its kind in Europe. In the present day commonly with its OSEVA Development and Research Ltd., daughter (subsidiary) company it focuses on research, grasses growing, buckwheat and white lupine, with pesticide testing, foreign propagation, counselling and services. It links up to legacy of N. I. Vavilov and J. G. Mendel first of all by an activity in the field of gathering, valuation, conservation and utilization of genetic sources of grasses which it secures within the framework of the National Programme on Conservation and Utilization of Plant Genetic Resources and Agrobiodiversity of the Czech Republic.

Grassland Research Station in Zubří *(photo M. Lošák, 2013)*

The well-known Czech firm **Černý Seed Company,** Jaroměř is a successful application of knowledge of Mendel, Vavilov, Frimmel, Lužný and of other personalities of world genetics and breeding into the operational gardening practise. This company has more than 150 years breeding tradition. From the thirties of the past century they implement here a very successful breeding programme focusing on decorative plants, especially *Petunia hybrida, Begonia x tuberhybrida* and *Begonia semperflorens.*

Aerial view on the Černý Jaroměř firm *(photo archive of firm)*

SEMO Smržice – aerial view *(photo L. Rygl)*

The tradition of breeding in **Smržice** can be another example which has commenced with its activity already before World War II. Today a private breeder and seed grower and commercial company SEMO a.s. acts here with the headquarters in Smržice which has created its profile from a breeding station and it belongs among the most significant breeding firms of the Czech Republic occupying with the vegetables breeding with orientation especially on peppers, tomatos, cucumbers, parsley, carrot, lettuces, onion and garden peas.

The **Gene Bank of the Slovak Republic in Piešťany** which is part of **Research Institute of Plant Production** belongs to the most important institutions in Slovakia. The Gene Bank of the Slovak Republic is coordinator of National programme of protection of genetic sources of plants for nutrition and agriculture within the framework of the whole SR, it secures and guarantees the study, monitoring, gathering, identification, evaluation and long-term preservation of genetic sources of cultivated species of plants.

Piešťany – Gene Bank of SR *(photo L. Rygl, 2011)*

The sustainable utilization of genetic sources of plants is in the present day an extraordinarily topical theme. No matter how the discussions about natural resources are complicated and varied, one fact cannot be argued away: the plants are source of food for all animals thus also for the man. Therefore we cannot afford to lose out of regard the danger of the narrowing-down of genetic diversity of plants and creation of genetic uniformity. The research institutions, governments, international organizations also commercial sphere share this responsibility. The biological diversity has basic influence on sustainability of life on the Earth and it is necessary to protect it.

It is possible to develop any field of theory also practise only from knowledge of historical connections and continuities. The principles of heredity, which were described firstly by G. J. Mendel, defining of gene centres of plants evolution on the Earth by N. L. Vavilov and his formulation of the law of homological lines of heritable stability belong also today to basic pillars of contemporary modern cultivation.

Mendel University in Brno *(photo L. Rygl)*

Dedicated to the memory of Prof. Ing. Jan Lužný, Ph.D.,
emeritus professor of Mendel University in Brno
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