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## **HISTORY OF SUNFLOWER BREEDING IN UKRAINE AND THE CONTRIBUTION OF UKRAINIAN BREEDERS INTO SUNFLOWER BREEDING DEVELOPMENT**

This article contains a short review of the history of sunflower breeding in Ukraine and the contribution of Ukrainian breeders into sunflower breeding development.

Ukrainian scientist-breeders play a leading role in the creation of sunflower varieties and hybrids. The first domestic sunflower varieties 'Zelenka 76' and 'Kharkovskiy 22–82', which were sown in 1928 and 1930, respectively were created by Borys Yenken in Kharkiv. In the Plant Breeding and Genetics Institute (Odesa, Ukraine), Professor Victor Burlov was the first in Ukraine who created industrially valuable sunflower hybrids, the first domestic hybrid 'Rassvet' (1981) being among them. Academician of NAAS Victor Kyrychenko (Kharkiv, Ukraine) is the coordinator of sunflower breeding in Ukraine. He has created more than 80 hybrids ('Hector', 'Oreol', 'Yason', 'Kapral', et al.), formed a scientific school of sunflower genetics, breeding and seed production.

The special period in sunflower breeding is a trend to increase plant resistance to different pathogens. The group immunity breeding is an important tasks in improving thos oil crop.

**Key words:** history of sunflower breeding, agricultural science, Ukrainian breeders, sunflower varieties, heterosis, sunflower hybrids

**Aim.** The aim of the research is primarily to carry out a scientific historical analysis of the history of sunflower breeding in Ukraine and to estimate the contribution of the breeders of our country into sunflower breeding development.

**Discussion.** Today, oilseed sunflower is spread on almost all continents of the globe. It belongs to major oil plants of the world's farming. Sunflower gained its popularity due to the wide scope of application - from the decorative one to the food, raw material, energy and other major sectors of the economy. Since the advent of agriculture and sunflower domestication, new trends in use of this crop have appeared, and the existing ones have been improved by the development of science and technology as well as since the evolution of knowledge about sunflower.

It is known that the History of the sunflower begins on the American continent, where it has been cultivated by Indian tribes in the 3 - 4th century before Christ. Due to Columbus, sunflower got to the Old World in XVI, since then its chronicles have begun in Europe. The first prints and morphological descriptions of sunflower were found in Remberto Dodonaeo's, Joachim Camerarius der Jüngere's, Jacobus Theodorus Tabernaemontanus's, Szymon Syreński's, John Parkinson's, and other scholars' works of the past. Based on historiographic materials, a comprehensive investigation of the history and origin of sunflower and beginning of its chronicles in Europe was carried out; botanical descriptions and images of sunflower in century XVI - XVII (ancient engravings, xylography, paintings) were chronologically systematized; historical materials of morphological descriptions of sunflower in the past are given<sup>1</sup>. According to discovered existing images of this culture XVI – XVII to some extent can be traced breeding directions and manufacturability of sunflower in Europe at that time, but for a more exhaustive analysis are needed more thorough investigation. The author aims to explore it in the future.

Sunflower passed through difficult stages of development and won the struggle for survival. Despite the fact that in 1716 the British managed to obtain oil from sunflower and even patented the invention, this important discovery was never applied in Europe. These were Ukrainian and Russian breeders who created a sunflower as a technical culture.

E. I. Shuvalov said that it is difficult to determine which sunflower was brought to Europe, but

<sup>1</sup> Косенко, Р.О. (2015). Соняшник. Історія виникнення та введення в культуру. *Історія науки та біографістика*, 4, 20.

researchers believe that the likely cultural, not wild, and if not oilseed, it is likely «hryzovyy»<sup>1</sup> (for gnaw). In the late 19th century village Ploskoye (Kherson province, Tiraspol County) was the center of the cultivation of this sunflower species<sup>2</sup>.

Some researchers believe that, most likely, the sunflower was brought to Ukraine from Poland<sup>3</sup>. Other scientists believe that it was imported from Russia<sup>4</sup>. Most researchers recognize the fact that the first attempt to produce oil from sunflower seeds in Tsarist Russia belongs to a common Russian peasant from Voronezh province (now – the Belgorod region) D.S. Bokarev who extracted oil from sunflower seeds in 1829. And still earlier – in 1816 – 1817 – the issue of sunflower cultivation in the southern provinces to produce oil and use stems as fuel was considered by Kharkiv Filotechnical society, as recorded in protocols of this Union<sup>5</sup>.

In Ukraine, breeding scientific thought has been moving forward throughout all the stages: new breeds appeared on the stage of population selection, then they were improved, new ones, more yielding, productive and more resistant to disease and pests were created on their basis. With the development of science and the transition to heterosis breeding, the innovations that expand the range of practical use of the crop (e.g. advanced processing lines for the production of pellets, oils, biodiesel is the optimization of fatty acid composition, tocopherols, etc.) appeared. New opportunities in terms of use of sunflower as an object of transfer have appeared. But in all phases the work of the breeder has been complex and painstaking.

Agricultural enterprises of Ukraine are a fertile ground for the implementation not only of Ukrainian but also for global innovations. In this space, Ukrainian breeding successfully develops even under the economic crisis. Classic and new breeding techniques enable creating lines and hybrids that are resistant to main diseases and pests, with the best qualities of oil enriched in different fatty acids, vitamins and tocopherols. The yield capacity of new sunflower hybrids created at institutes of NAAS of Ukraine achieves 5.6 t/ha not only in experiment fields, but also at agricultural enterprises, and new PCR-methods (polymerase chain reaction) reveal a significant potential of breeding as a science.

Nowadays, the main originators of sunflower hybrids in Ukraine are Plant Production Institute named after V.Ya. Yuriev of NAAS (Kharkiv), Plant Breeding and Genetics Institute of NAAS (Odesa), Institute of Oil Crops of NAAS (Zaporizhya) as well as a number of non-government companies: ltd 'Sady Ukrainy' (ltd 'Gardens of Ukraine'), Ukrainian Research Institute of Breeding, ltd 'Flora' (ltd 'Flora»).

In Kharkiv, the beginning of sunflower breeding is associated with the name of professor Borys Yenken, who worked at Kharkiv Breeding Experimental Station since its organization – since 1908.

Borys Yenken's researches concerned with the development of crop breeding technologies, including sunflower (at that time it was the work aimed at creating varieties-populations). Kharkiv was the first center in Ukraine where Borys Yenken created domestic sunflower varieties 'Zelenka 76' and 'Kharkovskiy 22–82', which were sown in 1928 and 1930, respectively, and replaced low-yielding local varieties with low oil content<sup>6</sup>. The first selected varieties exceeded the local populations in terms of yield capacity and oil content by 0.2 – 0.5 t/ha and 3 – 5%, respectively. However, the main drawback of the first high oil content varieties was susceptibility to different pathogens but the pathogen resistant varieties had low oil content. Thus, a special period in the history of domestic breeding began: it was conducted for a set of traits (breeders were interested both in high oil content and high yield capacity, and resistance to pathogens such as sunflower moth, local broomrape races, rust, sunflower downy mildew). V.S. Pustovoyt notes that despite the efforts of breeders, sunflower development as a technical culture was spontaneous up to 30 years of the 20th century<sup>7</sup>. But by 1934 it was set up high-yielding varieties resistant to pathogens

<sup>1</sup> Шувалов, Е.И. (1990). *Краткий литературный обзор в помощь изучающим историю подсолнечника*. Краснодар, 55.

<sup>2</sup> Кириченко, В.В. (2005). *Селекция и семеноводство подсолнечника (Helianthus annuus L.)*. Харьков, 385.

<sup>3</sup> Кириченко, В.В. (ред.) (2010). *Спеціальна селекція і насінництво польових культур: навчальний посібник*. Харків, 462.

<sup>4</sup> Коваленко, Н.П. (2013). *Історичний шлях становлення соняшнику і його місце в сівозмінах України. Бюлетень Інституту сільського господарства степової зони НААН України, 4, 73-78.*

<sup>5</sup> Каразин, В.Н. (1910). *Сочинения, письма и бумаги В.Н. Каразина, собранные и редактированные проф. Д.И. Багалеем*. Харьков: В Университетской типографии. Т. XIX, 927.

<sup>6</sup> Вергунов, В.А. (2014). *Професор Єнкен Борис Карлович (1873–1943) – учений-селекціонер, педагог, організатор суспільної агрономії та вітчизняної сільськогосподарської дослідної справи*. Наукова доповідь. НААН України. Київ, ФОП Корзун Д.Ю., 26.

<sup>7</sup> Пустовойт, В.С. (1975). *Подсолнечник: монографія*. Москва, Колос, 592.

Zhdanovskiy 8281, Zhdanovskiy 6432, Armavirskiy 762, Armavirskiy 768 and other varieties. The introduction of these varieties into the agricultural production of Ukraine played an enormous role in the increase of oil production in the prewar period.

The special period in sunflower breeding is a trend to increase plant resistance to different pathogens. Breeding for group immunity is an important tasks in improving thos oil crop. Climate changes, active introduction of late-ripening varieties, increase in the crop acreage with violation of crop rotation havev led to the accumulation of white and gray mold pathogens. In 1984, laboratories for studying molds were created in Odesa and Kharkiv. The objective of these laboratories was also to estimate sunflower breeding material for resistance to gray and white molds. In a relatively short period, breeders initially created varieties-populations and later – the first generation hybrids (F<sub>1</sub>): Odeskyy 149, Kharkivskyy 49 and other hybrids, which were resistant to gray and white mold pathogens.

Heterosis sunflower breeding was founded by Victor Wolf. At the turn of the 50s (1957 – 1958) in Kharkiv under the direction of Victor Wolf who was the head of the sunflower breeding laboratory at that time and his staff Olexander Riabota, Lydia Dumachova started breeding work to create sunflower hybrids originally based on genetic male sterility, later – on cytoplasmic male sterility.

Sunflower breeding was started in Oilseeds Institute crops in February 1978 under the leadership of Alexander Nikolayevich Ryabota. He was one of the first researchers to heterosis breeding sunflower in Ukraine and in particular in the Zaporizhzhya region. Under his guidance were created hybrids 1 Zaporizhzhya – in 1980, in 1982 – Zaporizhzhya 2, 1985 – 5 Zaporizhzhya, written methodic recommendations on seed growing of sunflower hybrids<sup>1</sup>. Olexander Riabota studied meiosis, types of sunflower fertilization, gene male sterility. He managed to create several high-yielding hybrids: ‘Zustrich’ (together with Plant Production Institute named after V.Ya. Yuriev), ‘Zaporizkyy’, ‘Zaporizkyy 14’, ‘Baida’, etc.

To obtain valuable breeding material with group immunity, scientists began using interspecies hybridization, i.e. they used remote species to create interspecies hybrids. Interspecies cultivated sunflower hybrids created by Borys Pogorletskiy in Odesa and Victor Wolf in Kharkiv played an important role in the generation of line material that is now widely used in heterosis breeding. In addition, Victor Wolf was a remarkable methodologist: he developed and substantiated methods of heterosis breeding and seed production<sup>2</sup>.

Despite the fact that heterosis in plants (in tobacco, maize, etc.) has long been discovered, in sunflower breeding the possibility to use this effect appeared relatively recently. Significant development of heterosis in sunflower breeding was achieved due to the creation of forms that possessed cytoplasmic male sterility. Therefore, the discovery made by a French scientist P. Leclercq in 1969 concerning cytoplasmic male sterility in sunflower was a breakthrough, a revolution in the history of heterosis sunflower breeding.

In Plant Breeding and Genetics Institute (Odesa), Professor Victor Burlov was the first in Ukraine who created industrially valuable sunflower hybrids, among them the first domestic hybrid ‘Rassvet’ (1981) as well as hybrids ‘Odesskiy 122’, ‘Odesskiy 123’, ‘Odesskiy 249’, ‘Odesskiy 504’, ‘Zgoda’.

After Wolf, work on sunflower breeding in Kharkiv was continued by Anatoly Gumenyuk, who investigated the plant for productivity and oil content. Over the years, he created high oil content varieties ‘Kharkovskiy 100’, ‘Kharkovskiy 101’ and others. In fact, this breeder managed to achieve the biological maximum of oil content in sunflower varieties-populations seeds<sup>3,4</sup>. He is a representative of the Kharkiv breeding school. He worked in historical fracture time in sunflower breeding in Ukraine – the period of the transition from population to heterosis breeding. Anatoly Gumenyuk is a co-author of sunflower hybrids ‘Kharkivskiy 49’, ‘Kharkivskiy 58’, ‘Zustrich’, ‘Svitoch’, ‘Poglyad’<sup>5</sup>.

<sup>1</sup> Кутищева, Н.Н., Шудря, Л.И., Одинец, С.И., Серета, В.А., Цыс, И.С. (2014). Достижения по селекции подсолнечника в Институте масличных культур НААН. *Науково-технічний бюлетень Інституту олійних культур НААН*, 20, 136-149.

<sup>2</sup> Вольф, В.Г. (1968). *Гетерозис подсолнечника и использование цитоплазматической мужской стерильности*. Ленинград, Колос, 348-357.

<sup>3</sup> Кириченко, В.В., Гуменюк, А.Д., Ожерельева, В.М. (2008). *Юр'ївська школа рослинників (1908 – 2008)*. Харків, Магда ltd, 256.

<sup>4</sup> Гуменюк, А.Д. (1980). Селекция подсолнечника на Украине. *Селекция и семеноводство, вып. 46*. Киев, Урожай, 25-27.

<sup>5</sup> *Лаборатория селекции масличных культур (1979)*. Южное отделение ВАСХНИЛ, Украинский НИИ растениеводства, селекции и генетики им. В. Я. Юрьева. Харьков, 56.

Productive lines, sterility sources and pollen fertility-restorers created in the laboratory headed by him became valuable starting material for breeding heterosis sunflower hybrids in the future. Anatoly Gumenyuk is a domestic breeder, a scientist, who devoted over 50 years to the Institute of Plant Production Institute named after V.Ya. Yuryev (Kharkiv) and to sunflower breeding. This scientist wrote a large number of scientific works (more than 120) on breeding, seed production and agricultural technologies of sunflower cultivation, among which there are 14 copyright certificates (including creation of high-yielding sunflower cultivars zoned in different regions of the Ukrainian SSR)<sup>1</sup>. Anatoly Gumenyuk will celebrate the 90th anniversary on August 7, 2017.

The name of Academician of NAAS Victor Kyrychenko is connected with a special page in the history of breeding. For over 40 years, the scientist has been engaged in the development of theoretical bases of sunflower breeding and genetics and implementation of them in breeding practice. Currently, sunflower is not only the main oilseed crop in Ukraine, but also is a real national product. This product was created by Ukrainian scientists due to the modern breeding and genetic innovations. Academician of NAAS Victor Kyrychenko contributed a lot to these achievements. He is a permanent coordinator of sunflower breeding in Ukraine, the author of hybrid sunflower as the system, and object of transfer. And now this famous scientist continues to productive work for the benefit of national agricultural science<sup>2</sup>.

He created over 80 hybrids, formed a scientific school of sunflower genetics, breeding and seed production. His hybrids represent the entire spectrum of modern sunflower hybrids<sup>3</sup>:

- oleic hybrids ('Eney', 'Kvin', 'Bohun', 'Hector', 'Oreol') are targeted at improvement of nutritional quality of oil and contain 88-92% of oleic acid;
- linoleic hybrids ('Yason', 'Zlatson', 'Forvard') are notable for high potential yield capacity (5.5 t/ha) and high oil content in seeds (50.1%);
- palmitic hybrids ('Kapral', 'Kursor', 'Truvor', 'Rubikon') contain 22% of palmitic acid;
- confectionery hybrids ('Shumer', 'Forsazh', 'Hudvin') are distinguished by early ripening, high yield capacity and have 1000-seed weight over 120 g et al.

Viktor Kyrychenko created a scientific school of sunflower genetics, breeding and seed. I would say more, he created a national brand, and due to him, Ukrainian sunflower breeding reached the international level. Another achievement is the creation of innovative infrastructure. He organized a work of firms-satellites, which deal with practical implementation in production innovation in heterosis sunflower breeding. The Director of the Plant Production Institute named after V.Ya. Yuriev of NAAS, Doctor of Science in Agriculture, Professor, Academician of NAAS, Honoured Worker of Science and Technology, Laureate of the State Prize of Ukraine, Victor Kyrychenko will celebrate the 70th anniversary on November 28, 2016. And now this famous scientist continues to productive work for the benefit of national agricultural science.

#### **Conclusion.**

1. Oilseed sunflower passed through difficult stages of development and formation from its usage as an agricultural plant to empirical and later – science based breeding.
2. Ukrainian and Russian breeders created a sunflower as a technical culture. The main personalities in the History of Sunflower Breeding in Ukraine are Borys Yenken, Victor Wolf, Olexander Riabota, Lydia Dumachova, Borys Pogorletskiy, Victor Burlov, Anatoly Gumenyuk, Viktor Kyrychenko.
3. The special period in sunflower breeding is a trend to increase plant resistance to different pathogens. Breeding for group immunity is an important tasks in improving thos oil crop.
4. The discovery made by a French scientist P. Leclercq in 1969 concerning cytoplasmic male sterility in sunflower was a breakthrough, a revolution in the history of heterosis sunflower breeding. Nowadays Ukrainian heterosis hybrids represent the entire spectrum of modern sunflower hybrids.

<sup>1</sup> Анатолий Дмитриевич Гуменюк (Особова справа). Інститут рослинництва ім. В. Я. Юр'єва НААН.

<sup>2</sup> Косенко, Р.О. (2016). Академік НААН Віктор Васильович Кириченко. *Наукові записки Тернопільського національного педагогічного університету ім. Володимира Гнатюка. Серія: Історія, вип. 1, част. 4.* Тернопіль, вид-во ТНПУ, 161-165.

<sup>3</sup> Кириченко, В.В. (2002). *Теоретические основы селекции подсолнечника и практическое использование эффекта гетерозиса*: автореф. дис. на соиск. уч. степ. д-ра с.-х. наук: спец. 06.01.05. «Селекция и семеноводство». Институт зернового хозяйства УААН. Днепропетровск, 33.

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