

Introduction to the Special Issue Sunflower[☆]

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Sunflowers are grown on an increasing area in the world (over 28 million hectares in 2021, with a production of over 50 million tons (NSA) and its importance in human and animal nutrition is therefore increasing. As a result, more attention is paid to the issue of growing and processing sunflowers and all aspects of production that affect yield and quality. This is especially influenced by the large increase in sunflower prices on world markets in 2021, which will certainly continue in 2022, due to the war in Ukraine and the fact that production in Russia and Ukraine accounts for over 54% of world production. Investments in sunflower production are now becoming more profitable, but on the other hand, the price of all inputs, especially fertilizers, is also growing rapidly. This edition of OCL deals with a wide range of current topics, among which, new discoveries dominate in the field of breeding, cultivation in the conditions of global climate change and the fight against diseases, parasites and pests of sunflower.

The basis of any breeding program is genetic resources. The activities of three gene banks, in USA, France and Serbia, are described in detail, supplemented by data from seven other countries (Terzić *et al.*, 2020). Exploitation of heterosis for seed, oil yield and quality it is still in the focus of breeders (Ahmed *et al.*, 2021). In assessment of phenotypic variability among INTA (Argentina) sunflower lines, authors demonstrated the need for more in-depth study of genetic variability to be used as a predictor of heterosis in sunflower (Dominguez *et al.*, 2021). The high yield is ultimate goal but the compact habitus of sunflower plants (erectoid lives) is not a determining factor in the development of productivity of sowings with a high plant density (Bushnev *et al.*, 2021). Researchers are apparently increasingly focusing on the impact of global climate change, especially high temperatures and drought. Authors (Berton *et al.*, 2021) provided untargeted and targeted metabolomic data of sunflower leaves under water deficit. They constitute a valuable resource for the community to study the adaptation of crops to drought and the metabolic bases of heterosis. Innovative cropping systems based on low-input management, organic farming, soil and water conservation practices, intercropping, double-cropping, and/or agroforestry, so as new sunflower ideotyping are being investigated (Debaeke *et al.*, 2021). In some regions of Ukraine, edaphoclimatic factors account for 34 to 58% of the variation

in the yield trend parameters (Zymarioieva *et al.*, 2021). A study was initiated to develop new sunflower hybrids which may have higher seed yield and water use efficiency in current scenario of global climate change in Pakistan, parental inbred lines were selected on the basis of cell membrane injury and cuticular waxes (Gul *et al.*, 2021). In order to make more efficient plant breeding and gain in competitiveness, the “Sunflower” Joint Technological Unit) was launched in the Toulouse (France) area, focused on improving oil production through an agronomic approach. The result was the co-construction of a simulation model (SUNFLO) that can be parameterized (Debaeke *et al.*, 2020).

Sunflower diseases cause significant yield losses and also affect quality. The best way to fight is to grow resistant and tolerant hybrids. When it comes to downy mildew (*Plasmopara halstedii*), new races of this disease require constant work to introduce resistance. The final aim is the development of sunflower hybrids with the most durable resistance to downy mildew, combining one parental line with the major gene (PI15) most effective for the specific location and the second parental line with a high level of horizontal resistance to downy mildew (Goncharov and Goloschapova, 2021). As the sunflower growing area increases, so do the diseases. The first case of black stem (*Phoma macdonaldii*) on sunflower in China, has been recorded in 2008. After the identification of the pathogen, by examining 20 varieties of sunflower, 7 were found to have above-average resistance (Yan *et al.*, 2020). The situation is similar with the spread of the broomrape (*Orobanche cumana*) in China, due to inefficient plant quarantine. Authors (Shi and Zhao, 2020), give an overview of the current situation with the broomrape, and provide useful reference information for future research on the integrated control of sunflower broomrape in China. Sunflower is one of the crops most vulnerable to bird attacks. For this problem solution it is necessary to apply an integrated approach combining partially effective methods, the association of several stakeholders, and the coordination of several policies (agricultural, environmental, and recreational hunting or wildlife management) (Sausse and Levy, 2021).

In light of the global shortage of plant proteins, in addition to breeding methods, technological procedures are also used. A method to increase the protein content of sunflower meal was developed that uses a combination of milling, sieving and gravity tables to separate fractions with higher and lower protein content (Murru and Calvo, 2020). Pulsed electric field

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and pulsed microwave treatment can also be used in sunflower processing (Shorstkii *et al.*, 2019).

In the tough competition on the very dynamic vegetable oils and oilseed meals markets, respectively driven by palm oil and soybean meal, the sunflower sector succeeded in maintaining its competitiveness through continuous innovation in genetics, cropping practices and research of added value leading to higher market segmentation (Pilorgé, 2020). In times of global changes, not only climatic but also political, sunflower will have a bright future because of its anatomical and morphological properties that enable it to adapt to climate change, but also because of its characteristics that make it an oil-protein plant, not forgetting the possibility of increasing the quality of oil through the cultivation of high-oleic hybrids, hybrids with altered tocopherol content and the like. The contribution of the world scientific community will be decisive. 20th International Sunflower Conference to be held 20–23.06.2022 in Novi Sad, Serbia, organized by the Institute of Field and Vegetable Crops and the International Sunflower Association, will be an opportunity to give a new initiative to the intensification of multidisciplinary research on sunflower.

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