ISA NEWSLETTER December 2018

Editorial

The parasitic plant *Orobanche cumana* Wallr. is the most important biotic constraint to the production of sunflower crop, in all countries where sunflower is grown, except North and South America. The parasitism of *O. cumana* on sunflower dates back to the first half of 19th century in Russia, expanding to Moldova and Romania by the beginning of 20th century and later in others like Turkey, Spain, Serbia, Bulgaria and Ukraine. Currently, *O.cumana* is present in all countries in Southern Europe and areas around Black Sea, as well as in many countries in Asia.

The first mention to different races within *O. cumana* dates back to the beginning of 20th century, in Russia, by breeders developing sunflower varieties genetically resistant to races A and B. Later (1970-1980) in Romania there have been identified other three races: C,D,E as well as a set of sunflower genotypes, each of them carrying one single major gene of resistance. Races A to E were effectively controlled through genetic resistance for some decades, until race F has been identified.

Along the last decades, a new break of the genetic control of *O. cumana* has occurred in Turkey, Romania, Bulgaria, Russia, Ukraine, Spain, as a consequence of the crop intensification and short crop rotation, together with the use of genetic material from foreign breeding programs. There have been identified new highly virulent races, as G, H or more. Because in the last years, in China sunflower was growing very much as an oil crop, also as confectionery type, broomrape parasite has developed new races.

The appearance of new races considerably reduced the available sources of efficient resistance of cultivated sunflower. A high level of resistance was found in wild *Helianthus* spp., mainly in perennial ones.

Important efforts of breeders are devoted to the search of effective resistance against the increasingly virulent parasite populations and, as a result, resistant genotypes have been released.

Broomrape control can be also managed by development of IMI resistant hybrids or by using biological control.

Dr. Maria Joita-Pacureanu, Principal Researcher - Sunflower Breeding Department

NARDI Fundulea

Romania

Activity and News of the association:

SAVE THE DATE for the 20th International Sunflower Conference in Novi Sad, Serbia on June 22-25, 2020

The ISC2020 Organizing committee is delighted to inform you that the preparations for our next International Sunflower Conference are well under way. The Conference internet site will be accessible soon and updated as any new information becomes available. The main Conference program will start on June 22nd with three days of lectures and discussions followed by a field trip on June 25th. Registration at the Conference venue will be open from Sunday, June 21st as the arrival day, to ensure all participants can attend morning program sessions. We are looking forward to meeting you in Novi Sad, so - Save the Date!

The 4th Broomrape symposium in Bucharest on July 2-4, 2018

This symposium is the fourth specific symposium on broomrape in sunflower after those held in Turkey 2008, Moldova 2011 and Spain 2014. It has been organized by the National Agricultural Research and Development Institute of Fundulea and the University of Agronomic Sciences and Veterinary Medicine of Bucharest, with the ISA, under the coordination of Maria Pacureanu, and gathered 197 participants from 17 countries with large delegations from China, France, Romania, Ukraine, Serbia, Germany, Bulgaria, Moldova, Spain… Most countries concerned by the infestations of orobanche on sunflower and/or research on this topics - Central and Eastern Europe, Spain, Turkey, Israel, Iran, Karakhstan and China - were present. About 2/3 of the participants were from private companies' research and development, and 1/3 from public research and universities, reflecting the importance of such events for the coordination of research and innovation.

The symposium was introduced by Dr. Pompiliu Mustatea, director of the Institute of Fundulea and Dr Dumitru Manole, representing the Romanian farmers.

27 oral presentations and 26 posters have been presented, organized in 4 sessions on biology and genetics of the parasite (7+10), resistance mechanisms in sunflower (3 +2), genetic resistance (6+9) and herbicide tolerance and control methods (6+5), offering a quite complete overview of the diversity of the works on sunflower broomrape. The symposium ended with a workshop on the creation of an International Consortium on Sunflower broomrape resistance and was followed by a field trip to the Braila research station and Soare Constantin farm and research field near Constanza, in the East of Roumania.

Biology and genetics of *orobanche cumana*:

Philippe Delavault (University of Nantes) explained the interest of the focus on the germination process in the perspective to implement biocontrol methods of the orobanche. Using a transciptomic approach applied to *P. ramosa*, they showed that the germination stimulants produced by the host plant, induce a modification of only 28 transcripts over 2500 and that 2 of them induce a gene active in ABA catabolism, producing an enzyme CYP707A involved in the control of seed dormancy and germination. They conclude that *P. ramosa* seeds germinate after the endogenous ABA content reaches a sufficiently low level through CYP707A dependent catabolism triggered by the germination stimulants. The works carried out at Nantes and Toulouse on *O. cumana* permitted to obtain a reference transcriptome of *O. cumana*, a transcriptomic profiling during the broomrape development and an annotation of the *O. cumana* genome sequence. Works are going on with a PhD thesis (Sabrina Tourneur/ poster) and the project miPEPITO, aiming at identifying micropeptids involved in the regulation of specific target genes in orobanche and sunflower, in order to implement biocontrol methods.

Maria Joita-Pacureanu (National Agricultural research and Development Institute Fundulea) presented the current global situation of the sunflower broomrape which concerns 70% of the world production area and 60% of the production, and the evolution of broomrape populations. The newest populations determined in some countries were called G, H and I, but there is a doubt in the description of races in different countries, especially for the recent ones. To facilitate the communication and comparisons, propositions have been made for a universal adoption of the coded triplets system based on differential sets of sunflower lines, similarly to other plant pathogens. Sources of resistance to the races G and following have been identified in wild helianthus species. The presentation concludes on the necessity to complexify the breeding strategy, using pyramiding of single dominant *Or* genes, and use of quantitative non-race-specific tolerance. Using resistance to the AHAS-inhibiting herbicides is part of the strategies.

Xili Zhang (Sanrui Agri Tech) and Maria Duca (University of Academy of Science of Moldova) presented the status of orobanche monitoring in China and Moldova respectively. In China, the results show a trend towards a higher pressure of broomrape. Hybrids resistant to races E and F were developed, but a race G is present already in Inner Mongolia and will probably increase. In Moldova, broomrape has a long history since 1935 with races A and B; the latest monitoring results show a rather unfavorable situation with a higher presence of the parasite in the south of the country, with more than 60%of infested lands, and a gradient from south to north, but the latest races F, G, H are present in all regions. Molecular studies and phylogenetics have been achieved, showing a pathogen-host co-evolution. Jian Wang (Zejiang University) detailed the situation and control techniques in China Inner Mongolia: it seems that water soaking from irrigation can affect the vigor of *O. cumana* seeds and decrease their germination rate. Faisal Islam (Zejiang University) reviewed the possible management levers against orobanche, including agronomic ones. Luyang Hu (Zejiang University) studied the genetic diversity of sunflower broomrape populations in China, as revealed by genome re-sequencing: the study of Chinese orobanche populations showed no relation with geographical locations in China. A principal components analysis based on 231 SNP shared among 22 populations from 7 countries showed a link with geographical locations at world level (Europe and China) and that O. cumana in Inner Mongolia is different from populations in Europe.

Resistance mechanisms in sunflower

Alberto Martin Sanz (Corteva) presented a complete review of the resistance mechanisms to *O. cumana* in sunflower, distinguishing pre-attachment and post-attachment phases, the later one being divided in pre-haustorial and post-haustorial, and describing the mechanisms identified in the bibliography. The action of some of the major resistance genes may be attributed to a dominant mechanism (e.g pre-haustorial for *Or7*). Na Zhang et al (Zejiang University) tested in controlled conditions a pre-treatment of sunflower seeds with brassinolide, revealing positive effects on sunflower growth and biomass. Mireille Chabaud (INRA) presented the phenotyping device used in Toulouse for the study of the resistance of

sunflower to orobanche at early stages, in rhizotron with automatization of imaging and image analysis and optimization of the nutrient solution.

Genetic resistance

Leonardo Velasco (CSIC) introduced the session with a review of the recent developments of breeding for resistance against broomrape, pointing out a coexistence of more than one century between the crop and its parasite with a gene to gene resistance system, and a complexifying racial situation. The orobanche variability and increase in virulence is not due to the sole mutations: recent studies in Spain have shown the existence of a certain level of cross-fertilization and genetic recombination between individuals of different gene pools. Also in Bulgaria it was found that there was a gene flow between populations parasitizing wild hosts and populations parasitizing sunflower. Velasco listed and commented 5 complementary research strategies in a scenario of racial uncertainty: 1/Racial characterization of broomrape populations, 2/ Discovery of new resistance genes, 3/ Genetic and physiological characterization of resistance genes in sunflower, 4/ Genetic and physiological characterization of avirulence genes in broomrape, 5/ Developing diagnostic molecular markers for resistance and for avirulence genes. Concerning the 3rd strategy, he insisted on the fact that genetic and physiological characterization of the resistance are equally important in the perspective to associate genes pyramiding with a physiology based strategy.

Stéphane Munos (INRA) presented the works carried out in the French-Spanish Helior project: observing that cell walls modifications seem to be involved in both compatible and incompatible attachments and that genes from both broomrape and sunflower are expressed in the attachments samples of the two categories, the team carried out transcriptomic studies to measures the genes expression from both *O. cumana* and sunflower during the early stages of the interaction. For this, they produced a complete sequence and first genetic map of *O. cumana* using the segregating populations of *O. cumana* identified in Spain. Works on transcriptomics are going on to annotate the two genomes.

Dragan Skoric reviewed the progress in sunflower breeding for the resistance to orobanche and observed that the permanent change in populations of *Orobanche cumana Wallr*. hinders the success of breeding for resistance and concludes on the pregnant need of methods to compare the results of different studies and to evaluate the resistances.

Gerald Seiler (USDA) showed based on literature reports that sunflower is among the species for which the use of genetic resources from wild relatives is the most important, specially concerning resistances to biotic stresses. 37 sources of resistance to broomrape have been identified in wild relatives, 29 of them in perennials. Notably resistances to races E, F, G are available in several perennial Helianthus. The conclusion is that genetic resources are available but will require some effort to use them. The use of molecular tools would help in mining the genetic diversity and a good breeding strategy requiring global cooperation is needed. Marie Coque (Biogemma) presented the works carried out in the French research consortium Biogemma to decipher the broomrape resistance in sunflower wild relatives, combining genetic, biological and molecular approaches. Interspecific populations have been obtained by crosses between sunflower and wild relatives and genetics studies on one of these populations permitted to identify 4 regions associated to *O. cumana* resistance, which will be validated and studied for fine mapping and identification of candidate genes. Also a part of quantitative resistance has been found. Begoña Pérez-Vich (CSIC) reported the identification of a new source of resistance to race G from *H. praecox*, showing a trait controlled by partially dominant alleles at a single gene named *Orpra1*, giving a post-haustorial resistance, and located on LG4. Pauline Duriez (PhD thesis INRA-Syngenta-Toulouse Univ) reported her works about the characterization of the *HaOr7* resistance gene: it is located in a sequence containing genes coding for Leucine Rich proteins, is probably from wild origin and prevents the attachment to the roots.

Saida Guchetl explained the situation in Russia where race G already prevails and the works of VNIIMK on genetic control of race G: by screening the VNIIMK and Kuban Experimental station collections, 6

lines resistant to race G were developed by inbreeding. Cross breeding of the LG line with susceptible lines, back cross and progeny F2 were achieved to study the inheritance of the character. The observations gave 3 groups of resistant, sensible and intermediate plants, showing incomplete resistance. The resistance of RG line is inherited monogeneously with incomplete dominance. Other lines are still under study. Sandra Cvejic (IFVC) reported breeding studies on the line LIV17, the plants being characterized as susceptible when at least one broomrape is found on sunflower plants. She concludes to the presence of a single recessive *Or* gene.

Alberto Martin-Sanz (Corteva) presented the joint reflexions with the CSIC team on the basis of the orobanche diversity and racial distribution in Europe and the need to change the race nomenclature to be able to discriminate between the different pathotypes, and proposing a numerical system of triplets based on the response of the orobanche samples to 3 series of differential sunflower lines, similarly to the system used for downy mildew.

Jun Zhao (Inner Mongolia Agricultural University) introduced the Chinese special oil crops research system and the works concerning the orobanche monitoring and control. Petri dish tests observing the number of turbercules are used to evaluate the resistance/tolerance level of sunflower varieties. Oil type varieties showed higher resistance levels than confectionary. She reported the results of the test of a blocking agent in lab and greenhouse conditions, used by spraying or watering. This agent has no effect on seeds germination but could block the parasite on sunflower with a preserving effect of one month in greenhouse conditions.

Herbicide tolerance and control methods

Franziska Lerner (BASF) presented also the first results of the test of the use of the prohexadione calcium, a plant growth regulator, combined or not to IMI herbicide treatment: on the basis of a pot trial in Spain and a field trial in Turkey, the first results show a PHDC treatment effect on the total number of orobanche (higher effect with the lowest application rate in test) and indicate better results with a combined application of PHDC and Imazamox.

Johannes Bessai (BASF) highlighted the interest of imidazolinone herbicides and Clearfield system for completing the genetic control of orobanche specially in specific areas with a high pressure of Orobanche and the presence of very virulent races. He also pointed out the risk of development of orobanche biotypes resistant to these herbicides as for any weed species and concludes that a “golden standard” for broomrape control would associate Clearfield sunflowers with the latest genetic broomrape resistance, that would also allow the genetic resistances to stay longer in the market and gain time for new breeding developments. Then he gave comparative information on the two imazamox systems Clearfield and Clearfield plus. Luis Carlos Alonso (Syngenta) reminded of important basic elements of the biology of orobanche, conditioning the success of the control strategies: the fields are infested by mixtures of different races, the characterization of races by letters is not reliable when considering different countries, and the importance of the wind in the dispersion of the orobanche seeds seems to be quite relative. Strategies combining genetic, chemical control and agronomic practices including long rotations and trap crops seem to have shown the possibility to eradicate orobanche in one irrigated farm in Spain, at the opposite of previous heavy eradication programs on parasitic plants in Australia and USA. Yelcin Kaya (Trakya University) informed about the breeding programs in Turkey for cultivars combining IMI herbicides tolerance and genetic resistances to broomrape and downey mildew and concluded on the need to better understand the resistance mechanism and develop screening on these mechanisms. Nesho Neshev (university of Plodiv – Bulgaria) presented a complete test of the IMI herbicides on tolerant cultivars in infested conditions with assessment of phytotoxicity effects and observation of significant effects on seeds weights and seeds relative density and concludes on practical recommendations.

Call for collaboration

The last session of the symposium was devoted to a workshop on the constitution of **an International consortium on Sunflower broomrape resistance**, on a joint initiative of CSIC and INRA, whose purpose is to bring together a wide range of public and private partners working on the sunflower broomrape system to define and implement long-term research and control strategies. The operational objectives are a) to define a clear set of differential lines to universally classify broomrape races, b) to develop a collection of well-characterized broomrape populations based on their virulence degree, c) to use these collected genetic resources for molecular diversity, d) to progress on the functional characterization of the interaction at all stages (from seeds to flowering shoot). Open to public and private, the funding would come from private companies and from public projects, on the principles of sharing the part of the results that fit the objectives.

The initiative meets a real need expressed all along the symposium and the comments were generally positive and expressed mainly recommendations to step forward. A company expressed its interest for a large international network including all concerned countries, and another one alerted on the difficulty to exchange inbred material with certain countries. The initiative being presented with rather short deadlines, some recommended to take enough time to agree on the contents.

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This symposium has been sponsored by BASF, Aspria Seeds, Corteva Agriscience, Syngenta, Mas Seeds, Saaten Union, and Donau Saat, AISR, Alta Seeds.

Most slides presentations of the symposium are available on the ISA website members' space.

Carlos Feoli

We are deeply saddened to inform ISA members of the passing of Mr Carlos FEOLI, ASAGIR CEO and member of the ISA Board and former President of ISA, on September 28th, 2018, after a very short disease.

Mr. Feoli was a very well-known member of our community and his contribution as a longtime member, president of the ISA board and key organizer of the Sunflower Conference In Mar del Plata, will remain forever remembered.

Our colleagues of ASAGIR dedicated a web page to Carlos Feoli : www.asagir.org.ar/informacion-de-fallecio-carlos-feoli-fundador-y-director-ejecutivo-de-asagir-583

Value chains and regional news

Sunflower production and processing in Romania

Romania, as member of the European Union is situated on the 6th place in the European Community agriculture, taking into consideration the utilized agricultural surface.
Romania has the largest area cultivated with sunflower in EU. Each year it is cultivated around 1 million hectares.

Many foreign and Romanian seed companies produce and sell sunflower hybrid commercial seed in Romania. Romanian farmers prefer to cultivate sunflower hybrids resistant to herbicides, also resistant to broomrape, in most of area.
Romania releases the highest sunflower seed production in EU. In 2017 year, on 1,010 million hectares it has been obtained 3,16 million tones. Unfortunately, 60% of obtained seeds go to export and only 40% is processed inside of the country. Romania exports also sunflower oil, the export/year being 2,7 higher comparing with import.
In Romania sunflower is the largest source of vegetable oil, followed by soybeans, canola and corn.
There are many oil factories which are producing oil with very high quality: good color, good smell, high nutritive value (90% unsaturated fatty acids), high stability, high capacity for long period of conservation. The oil factories have different capacity of sunflower seeds processing: from 500 to 2200 tones/day.
The oil factories in Romania are developing the oil production under the quality concept and the assurance of food safety. There are some factories which started the oil production for many years (19th century) and most of them have certifications for quality gave by Lloyd's Register Quality Assurance (LRQA). There are producing 22 types of sunflower oil for food consumption, in Romania.
In the last years there have been developed the factories for producing sunflower crude oil, obtained by cold pressing method. Many of these are kind of family factories, but they are producing very healthy and high quality oil (many Awards received at some International Exhibitions). Very famous are CARDINAL and ELIXIR brands.

Sunflower production and processing in Serbia

According to the Statistical office of the Republic of Serbia, the current year has been a record one for sunflower production. Compared to 2017, sunflower production increased by 35.7%. Compared to ten-year average (2008-2017), production of sunflower increased by 58.5%. Total area with sunflower was 239.148 ha, with average yield of 3.068 kg/ha and total production of 733.706 tons.

Scientific news

Current works

PhD Thesis by Georgi Georgiev: "*Study on the biological and economic characteristics of new sunflower (Helianthus annuus L.) lines and their hybrid combinations*"

The research was carried out during 2012 – 2016 at Dobrudzha Agricultural Institute – General Toshevo. It included 11 fertility restorer lines and 5 sterile lines. Twenty-six hybrid combinations were also investigated according to the following qualitative and quantitative parameters: plant height, head diameter, stem thickness, number of branches, number of seeds per plant, weight of seeds per plant, 1000 kernel weight, leaf area, number of leaves per plant, seed set rate, full and empty seeds, percent of protein, percent of oil, seed yield - kg/da. The result obtained gives the authors a reason to summarize how much specific contributions they make:

- A modified methodology for fast leaf area determination has been proposed.
- It was established a correlation between all investigated indices.
- The cluster analysis performed for each indicator shows the proximity of the new lines and hybrids and their relation to the individual indices.
- The pattern of inheritance was established for all investigated indices.
- A positive and negative heterosis effect has been studied and analyzed.

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CUCEREAVII Aliona "Important agro-biological traits of sunflower germplasm for obtaining of high performance hybrids", PhD thesis in agricultural sciences, Chisinau, Republic of Moldova, 2018. *http://www.cnaa.md/thesis/54004/*

For the first time in Moldova, a broad assessment of the parental sunflower lines with different genetic origin (local, European, VIR and VNIIMK collections) was performed on the basis of agro-economic, morphological and physiological indices with the involvement of some of them in creating highly productive hybrids, resistant to the pathogen complex and stress factors. The vegetation period and the average duration of the main phenological phases of the material included in the study were established. The potential for downy mildew and rust resistance of sunflower germplasm of the company "AMG - Agroselect Comert" SRL was revealed.

Different techniques have been applied for the creation of the initial breeding material, using the molecular and traditional breeding methods, which allowed the efficient evaluation and selection of perspective sunflower genotypes, and their classification in groups of interest based on economic, morphological and physiological indices and the presence of disease resistance genes (Pl and R), which ensures the efficiency of the breeding process and creation of highly competitive hybrids.The data obtained contributes with new information in highlighting the heterosis manifestation rules and the inheritance of valuable characters such as genes for biotic resistance and the identification of germplasm of interest for breeding. Lines containing the resistance genes Pl1, Pl6 and R1 were recommended for use in the breeding process to create the initial downy mildew and rust resistant material.

Gisca Ion, ASPECTS RELATED TO SUNFLOWER PARASITE *OROBANCHE CUMANA* WALLR WITH SPECIAL REFERENCE TO GENETIC RESISTANCE, PhD dissertation in Agricultural Sciences, Chisinau, Republic of Moldova, 2018. *http://www.cnaa.md/thesis/54007/*

The purpose was to evaluate the virulence and impact of different populations of broomrape on the productivity indexes and the screening of sunflower germplasm to obtain resistant hybrids. The approach was focused on the comprehensive analysis of the evolution of broomrape races and their virulence, in parallel with the germplasm evaluation related to parasite resistance, the study of genetic determinism of resistance and extensive comparative assessments of experimental hybrids in the field to reveal the impact of the broomrape on the qualitative and quantitative indices of productivity. For the first time, the genetic, molecular and physiological screening of sunflower genotypes used for breeding has been done and a series of perspective lines and hybrids resistant to broomrape under natural and artificial infection conditions were identified.

The methodology for breeding to broomrape resistance using the complex of molecular, laboratory and field experiments, allowed the revealing of the Or 5 gene in the most lines, the association of RAPD primers with resistance, tolerance and sensitivity to broomrape, identification of new sources of resistance and demonstration of the possibility for Or's genes transferring to perspective lines through backcross. The analysis of the genetic determinism of resistance to broomrape and identification of the mechanism of inheritance of dominant genes Or, demonstrates that resistance to the races of O. cumana more virulent than F is controlled by several genes and not just by a single dominant gene, as in the case of less virulent races (from A to F). These results of genetic determinism found up in two lines resistant to new races with increased virulence are of interest in the creation of resistant hybrids. Using the sources of resistance to O. cumana Wallr. the resistance genes were transferred to elite lines. Sunflower hybrids resistant to broomrape were created, 7 of them have been admitted by the State

Commission for Variety Testing. A method of early diagnosis of broomrape attack that allows rapid analysis of a large number of genotypes in a short time has been developed.

Publications

GENETICS AND BREEDING

New ideotypes of oil & protein crops. Patrick Vincourt. 2018 https://doi.org/10.1051/ocl/2018062

Using ideotypes to support selection and recommendation of varieties. Arnaud Gauffreteau, 2018. https://doi.org/10.1051/ocl/2018042

Alternative breeding processes: at which extent Participatory Breeding should modify the concept of ideotypes in plant breeding? Patrick Vincourt & Pierre Carolo. 2018 https://doi.org/10.1051/ocl/2018061

Effect of Ahasl1-1 and Ahasl1-4 alleles on herbicide resistance and its associated dominance in sunflower. Gabriela Breccia, Laura Gianotto, Emiliano Altieri, Mariano Bulos, Graciela Nestares. Pest Management Science Sept 2018. https://doi.org/10.1002/ps.5197

Data describing the eco-physiological responses of twenty-four sunflower genotypes to water deficit. Nicolas Blanchet, Pierre Casadebaig, Philippe Debaeke, Harold Duruflé, Louise Gody, Florie Gosseau, Nicolas B.Langlade, Pierre Maury . Data in Brief https://doi.org/10.1016/j.dib.2018.10.045

SSR Markers Suitable for Marker Assisted Selection in Sunflower for Downy Mildew Resistance / Ezgi Çabuk Şahin, Aral Kalenderoğlu, Yıldız Aydın, Göksel Evci, Ahu Altınkut Uncuoğlu. Open Life Sciences. https://doi.org/10.1515/biol-2018-0039

Genetic Diversity of a Germplasm Collection of Confectionery Sunflower Landraces from Spain. B. Pérez-Vicha, M. R. Aguirrea, B. Gutaa, J. M. Fernández-Martíneza and L. Velasco https://doi.org/10.2135/cropsci2018.02.0108

Registration of Oilseed Sunflower Germplasms HA-BSR2, HA-BSR3, HA-BSR4, and HA-BSR5 with Resistance to Sclerotinia Basal Stalk Rot and Downy Mildew . L. L. Qi, Z. I. Talukder, Y. M. Long and G. J. Seiler. Journal of Plant Registrations. https://doi.org/10.3198/jpr2017.11.0083crg

Sunflower Genetics from Ancestors to Modern Hybrids - A Review / Aleksandra Radanovic , Dragana Miladinovic, Sandra Cvejic, Milan Jockovic and Siniša Joci´ . Genes. https://doi.org/10.3390/genes9110528

Comparison of methods for the estimation of best parent heterosis among lines developed from interspecific sunflower germplasm. Nada Hladni, Miroslav Zorić, Sreten Terzić, Nataša Ćurčić, Zlatko Satovic, Dragan Perović, Dejana Panković. Euphytica Jul 2018 https://doi.org/10.1007/s10681-018-2197-0

Genetic Characterization of Maximilian Sunflower for the Development of a Locally Adapted Perennial Grain Oilseed. Asselin, S. R., A. L. Brûlé-Babel, and D. J. Cattani. 2018. Crop Sci. 58:2241-2260. https://doi.org/10.2135/cropsci2017.10.0611

Pre-Print: Heliaphen, an outdoor high-throughput phenotyping platform designed to integrate genetics and crop modeling. Florie Gosseau, Nicolas Blanchet, Didier Varès, Philippe Burger, Didier Campergue, Céline Colombet, Louise Gody, Jean-François Liévin, Brigitte Mangin, Gilles Tison, Patrick Vincourt, Pierre Casadebaig, Nicolas Langlade https://doi.org/10.1101/362715

Effect of cold pre-treatment on regeneration in sunflower anther culture/ Dragana Miladinović, Andrea Majoroš, Aleksandra Dimitrijević, Slobodanka Pajević. August 2018. Conference: International

Association for Plant Biotechnology Congress At: Dublin, Ireland. https://www.researchgate.net/publication/327727518_Effect_of_cold_pre-treatment_on_regeneration_in_sunflower_anther_culture

Sunflower breeding for well developing in conditions of the climate change/ Gabriel Florin ANTON, Călina Petruţa CORNEA, Maria JOIŢA PĂCUREANU, Luxiţa RÎŞ NOVEANU, Mihaela POPA, Alexandru BRAN, Eliza SAVA , Florentina SAUCA/ https://www.researchgate.net/profile/Anton_Florin_Gabriel/research

Special Downy mildew: *Our colleagues from the INRA-LIPM team inform us of this internet-news on "the recent articles accepted for publication in Plant Journal and in Frontiers in Plant Science on downy mildew resistance in which Felicity Vear contributed so much". (Felicity Vear played an active role in ISA as a researcher, President and then General Secretary of ISA).*

Thanks to long work on valorization of natural genomic resources and to the development of new genotyping technologies, scientists and technicians at the plant-microorganisms interactions laboratory (LIPM) have improved understanding of infection mechanisms which should help to reinforce disease resistance of sunflower in the field. (see http://www.toulouse.inra.fr/en/All-the-news/mildew). *These works are published under two references concerning the identification and understanding of the virulence factors and the mapping of ten new resistance genes.*

Sunflower resistance to multiple downy mildew pathotypes revealed by recognition of conserved effectors of the oomycete *Plasmopara halstedii*. Yann Pecrix, Luis Buendia, Charlotte Penouilh-Suzette, Maude Maréchaux, Ludovic Legrand, Olivier Bouchez, David Rengel, Jérôme Gouzy, Ludovic Cottret, Felicity Vear, Laurence Godiard. Plant J. 2018 Nov 13. https://doi.org/10.1111/tpj.14157

Ten broad spectrum resistances to downy mildew physically mapped on the sunflower genome. Yann Pecrix, Charlotte Penouilh-Suzette, Stéphane Muños, Felicity Vear and Laurence Godiard. Front. Plant Sci. https://doi.org/10.3389/fpls.2018.01780

PATHOLOGY / CROP PROTECTION

Recent advances on the characterization and control of sunflower **soilborne pathogens** under climate change conditions. Molinero Ruiz Leire 2018 Article OCL DOI: https://doi.org/10.1051/ocl/2018046

Influence of environmental conditions on the virulence and distribution of **Orobanche cumana** Wallr. in the Republic of Moldova. Maria Duca, Steliana Clapco, Maria Nedealcov et Lidia Dencicov. 2018. DOI: https://doi.org/10.1051/ocl/2018049

Genetics, Host Range, and Molecular and Pathogenic Characterization of **Verticillium dahliae** From Sunflower Reveal Two Differentiated Groups in Europe. Alberto Martín-Sanz, Sandra Rueda, Ana B. García-Carneros, Sara González-Fernández, Pedro Miranda-Fuentes, Sandra Castuera-Santacruz and Leire Molinero-Ruiz. 2018. Front. Plant Sci., 09 March 2018 | https://doi.org/10.3389/fpls.2018.00288

Alternaria alternata, the causal agent of leaf blight of sunflower in South Africa. M. G. Kgatle & M. Truter & T. M. Ramusi & B. Flett & T. A. S. Aveling. 2018. Eur J Plant Pathol (2018) 151:677–688 https://doi.org/10.1007/s10658-017-1402-7

First Report on the Occurrence of a Globally New Pathotype, 724, of **Plasmopara halstedii** Causing Sunflower Downy Mildew in Hungary / R. Bán, A. Kovács, and K. Körösi, M. Perczel, G. Turóczi, M. Zalai, Z. Pálinkás, and M. Égei. Plant Disease September 2018, Volume 102, Number 9 https://doi.org/10.1094/PDIS-10-17-1609-PDN

The Colonization Process of Sunflower by a Green Fluorescent Protein-Tagged Isolate of *Verticillium dahliae* and its Seed Transmission/ Y. Zhang, J. Zhang, J. Gao, G. Zhang, Y. Yu, H. Zhou, W. Chen, and J. Zhao . Plant Disease Sep 2018, Volume 102, Number 9 Pages 1772-1778/ https://doi.org/10.1094/PDIS-01-18-0074-RE

AGRONOMY

Response of Sunflower to Nitrogen and Phosphorus in North Dakota. Eric Schultz, Thomas DeSutter, Lakesh Sharma, Gregory Endres, Roger Ashley, Honggang Bu, Samuel Markell, Austin Kraklau, and David Franzen. 2018. Agronomy Journal • Volume 110, Issue 2 • 2018 685. https://doi.org/10.2134/agronj2017.04.0222

Effect of methods of irrigation and sulphur nutrition on seed yield, economic and bio-physical water productivity of two sunflower (Helianthus annuus L.) hybrids. Priyanka Sahoo, A.S. Brara, Sanjula Sharmab. 2018. https://doi.org/10.1016/j.agwat.2018.05.009

Preprint: Vigour/tolerance trade-off in cultivated sunflower (Helianthus annuus) response to salinity stress is linked to leaf elemental composition/ Andries Temme, Kelly L Kerr, Lisa A Donovan. https://doi.org/10.1101/447128

3D Leaf Tracking for Plant Growth Monitoring / William Gélard ; Ariane Herbulot ; Michel Devy ; Pierre Casadebaig . 25th IEEE International Conference on Image Processing. https://doi.org/10.1109/ICIP.2018.8451553

Sunflower oil yield responses to plant population and row spacing: vegetative and reproductive plasticity/ M. LópezPereira, A.J.Hall, Field Crop Research / https://doi.org/10.1016/j.fcr.2018.09.014

Significant Pollination Services to Confection Sunflowers (Helianthus annuus L.) (Asterales: Asteraceae) Grown Across the Northern Great Plains / Rachel E Mallinger, Jeff Bradshaw Adam, J Varenhorst, Jarrad R Prasifka / Journal of Economic Entomology, toy322, https://doi.org/10.1093/jee/toy322

Medicinal value of sunflower pollen against bee pathogens. Jonathan J. Giacomini, Jessica Leslie, David R. Tarpy, Evan C. Palmer-Young, Rebecca E. Irwin & Lynn S. Adler. 2018. Scientific REPORTs | (2018) 8:14394 | https://doi.org/10.1038/s41598-018-32681-y .

Bee Pollination Highly Improves Oil Quality in Sunflower/ Carina A. S. Silva, Wesley A. C. Godoy, Cynthia R. O. Jacob, Gustavo Thomas, Gil M. S. Câmara, Denise A. Alves/ http://dx.doi.org/10.13102/sociobiology.v65i4.3367

Yield loss in sunflower cultivars due to bird attack / Paulo Sérgio Lima e Silva, Francisco Linco de Souza Tomaz, Patrícia Liany de Oliveira Fernandes Siqueira, Paulo Igor Barbosa e Silva, Levi Afonso Cavalcante de Lima/ http://ccarevista.ufc.br/seer/index.php/ccarevista/article/view/5884

PROCESS AND PRODUCTS

Evaluation of Lipases from Wild Microbial Strains as Biocatalysts in Biodiesel Production/ Carlos Luna, Diego Luna, Felipa M. Bautista, Juan Calero, Antonio A. Romero, Alejandro Posadillo, Enrique D. Sancho and Rafael Estevez. Separations, 5(4), 53; https://doi.org/10.3390/separations5040053

Sunflower oil transesterification with methanol using immobilized lipase enzymes/ Encinar, J.M., González, J.F., Sánchez, N. et al. Bioprocess Biosyst Eng (2018). https://doi.org/10.1007/s00449-018-2023-z

Investigation of activated carbon obtained from the liquid products of pyrolysis in sunflower oil bleaching process/ Guliyev, N.G., Ibrahimov, H.J., Alekperov, J.A. et al. Int J Ind Chem (2018) 9: 277. https://doi.org/10.1007/s40090-018-0156-1

Improvement in the functionality of spreads based on milk fat by the addition of low melting triacylglycerols/ Rodolfo Lázaro Soares Viriato, Mayara de Souza Queirós, Maria Isabel Landim Neves, Ana Paula Badan Ribeiro, Mirna Lúcia Gigante. Food Research International. https://doi.org/10.1016/j.foodres.2018.10.082

Development of the prawn and tilapia feed using sunflower cake substituting fish meal for improved freshwater gher/ PHDThesis MM HOSSAIN – 2018/ https://www.researchgate.net/profile/Mohammad_Hossain152/research

Heat treatment of sunflower protein isolates near isoelectric point: Effect on rheological and structural properties/ Mudasir AhmadMalik, Charanjiv SinghSaini/ https://doi.org/10.1016/j.foodchem.2018.10.060

ECONOMY AND MARKETS

Considerations concerning worldwide production and marketing of sunflower seeds. SOARE, Elena; CHIURCIU, Irina-Adriana Source: Scientific Papers: Management, Economic Engineering in Agriculture & Rural Development. 2018, Vol. 18 Issue 3, p421-427. 7p.

Ideal oil and protein crops – what are users ideotypes, from the farmer to the consumer? Perrine Tonin, Nathalie Gosselet, Emélie Halle and Marjorie Henrion. OCL. Dec 2018. https://doi.org/10.1051/ocl/2018060

IN HELIA: Ahead of prints: *see https://www.degruyter.com/view/j/helia (free access for ISA members through http://isasunflower.org/ and login to Members Space.*

Occurrence and Distribution of Races 713, 733 and 734 of Sunflower Downy Mildew Pathogen in the Russian Federation. Maria Iwebor/ Tatiana Antonova/ Svetlana Saukova. Published Online: 2018-11-13 | DOI: https://doi.org/10.1515/helia-2018-0015

Occurrence and Distribution of Races 713, 733 and 734 of Sunflower Downy Mildew Pathogen in the Russian Federation. Iwebor, Maria / Antonova, Tatiana / Saukova, Svetlana. Published Online: 11/13/2018

Magnitude and Nature of Gene Effects Controlling Oil Content and Quality Components in Sunflower (Helianthus annuus L.) Chahal, Ravneet Kaur / Dhillon, S. K. / Kandhola, S. S. / Kaur, Gurpreet / Kaila, Vineeta / Tyagi, Vikrant / Published Online: 11/09/2018

Stability Analysis of Some Novel Cytoplasmic Male Sterile Sources of Sunflower and Their Hybrids. Tyagi, Vikrant / Dhillon, S. K. / Kaushik, Prashant/ Published Online: 11/01/2018

Characterization of Non-Target-Site Mechanisms in Imidazolinone-Resistant Sunflower by RNA-seq/ Gil, Mercedes / Vega, Tatiana / Felitti, Silvina / Picardi, Liliana / Balzergue, Sandrine / Nestares, Graciela/ Published Online: 11/01/2018

The Influence of nano-TiO2 and Nano-Silica Particles Effects on Yield and Morphological Traits of Sunflower/ Sabaghnia, Naser / Javanmard, Abdollah / Janmohammadi, Mohsen / Nouraein, Mojtaba. Published Online: 10/31/2018

Combining Ability of Sunflower Inbred Lines under Drought Stress / Ghaffari, Mehdi / Shariati, Farnaz . Published Online: 10/25/2018

Treatment by Trait Biplot Analysis of Organic Manure and Nano-Fertilizers on Sunflower Production / Sabaghnia, Naser / Yousefzadeh, Saeed / Janmohammadi, Mohsen. Published Online: 02/17/2018

Coming International and national events

5-8 May, 2019: AOCS Annual Meeting, St Louis, Missouri, USA. http://annualmeeting.aocs.org/

7-10 July 2019, 9th European Symposium on Plant Lipids Marseille, France

18-21 September 2019: European Conference on crop diversification. Budapest, Hongrie. https://www.cropdiversification2019.net/call-for-abstracts.html

20-23 October 2019, 17th Euro Fed Lipid Congress and Expo. Seville, Spain

9-12 February 2020. World congress on oils and fats. Sidney, Australia. www.wcofsydney2020.com

22-25 June 2020, 20th International Sunflower Conference, Novi Sad, Serbia

We invite all the persons who read this newsletter to share information with the Sunflower community: let us know the scientific projects, events organized in your country, crops performances or any information of interest for sunflower R&D.

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