

19TH INTERNATIONAL SUNFLOWER CONFERENCE



isc 2016

29 MAY – 3 JUNE, 2016

EDİRNE, TURKEY





ISC 2016



**PROCEEDINGS
OF
19TH INTERNATIONAL SUNFLOWER
CONFERENCE**

29 MAY – 3 JUNE, 2016

EDİRNE, TURKEY

**19TH INTERNATIONAL SUNFLOWER
CONFERENCE**

**29 MAY – 3 JUNE, 2016,
EDIRNE, TURKEY**

In

**Trakya University Balkan Congress Center,
Edirne, Turkey**

Organized by

Trakya University

and

International Sunflower Association

WELCOME from the CHAIR

You are welcome to our conference that will be jointly organized by Trakya University and International Sunflower Association. The aim of our conference is to present scientific subjects of a broad interest to the sunflower community, by providing an opportunity to present their work as oral or poster presentations that can be of great value for global sunflower production and trade. Our goal is to bring three communities, namely science, research, and private investment together in a friendly environment of Edirne, Turkey in order to share their interests and ideas and to benefit from the interaction with each other.

Our Conference held with record participation with over 600 people working on sunflower as researchers, scientists from seed companies, from oil industry and machinery coming from all part of the World. We have 300 papers which is a record number and almost doubles the previous meetings.

Due to many inquiries about combining our activities with oil industries in ISC 2016, International Sunflower Oil Quality Symposium are organized as one day as a side event during the conference. Sunflower farmers and growers will join also to our conference, so it will be also interesting as an initial attempt to bring together triangle dimensions as scientist, growers and industry in our conference.

Conference activities;

Plenary sessions with oral and poster presentations are on 30th, 31st of May and 1st of June 2016. Besides, the field day and the Sightseeing tours are on June 2nd – 3rd June 2016.

Agriculture is an important sector feeding all humankind, but it needs new developments and technologies to supply enough food for increasing world population year by year. Turkey is one of the most important contries on sunflower production and trade and an example to the leading agricultural economies in the world. Therefore, we hope that this conference will help to solve the problems encountered in the Sunflower community with establishing good network collaborations, joint projects and better relationships among countries with sharing our knowledge and experience together. We wish success to this meeting and hope a great scientific achievement together with your contributions.

Edirne is not only a very nice, lovely and historical city at the edge of Europe, but located just at the heart of Balkan region and history endowed with monuments reminding imperial past. We are much pleased to host you all in Edirne and in Turkey.

We would like to thank you to join this conference and we would like to give also special thanks our sponsors and collaborators for giving us big supports to organize this event.

We wish you nice stay in Edirne for truly rewarding days.

Assoc Prof Dr Yalcin KAYA

Head of Organizing Committee

President of International Sunflower Association

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Dr. Janet KNODEL	North Dakota State Univ.	USA	Sunflower Insects

INVITED SPEAKERS of ISC 2016

SESSIONS

Breeding
Molecular Breeding
Agronomy and Seed Production
Genetic Resources
Disease & Pest resistance and Management
Orobanche Resistance and Management
Abiotic Stress Tolerance and Management
Herbicide Resistance and Management
Confectionery

SPEAKER

Dr Branislav DOZET (Hungary)
Dr. Lili QI (USA)
Dr Philippe DEBAEKE (France)
Dr Laura MAREK (USA)
Prof Dr Steven MASIREVIC (Serbia)
Dr Maria JOITA-PACUREANU (Romania)
Dr Nicolas LANGLADE (France)
Dr Goran MALIDZA (Serbia)
Dr Nada HLADNI (Serbia)

INVITED SPEAKERS of INTERNATIONAL SUNFLOWER OIL QUALITY SYMPOSIUM

NAME	INSTITUTION	COUNTRY
Prof Dr Nurhan T. DUNFORD	Oklahoma State Univ.	USA
Fabrice THURON	Fat & Associates,	FRANCE
Dr Leanordo VELASCO	CSIC, Cordoba,	SPAIN

THE EDITORS OF PROCEEDING BOOK

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19TH INTERNATIONAL SUNFLOWER CONFERENCE
29 MAY – 3 JUNE, 2016
EDIRNE, TURKEY

CONFERENCE PROGRAM

GENERAL SESSION

SUNDAY, MAY 29th, 2016	
14 ⁰⁰ - 20 ³⁰	Registration at Hotels and Balkan Congress Center
MONDAY, MAY 30th, 2016	
08 ³⁰ - 09 ³⁰	Registration at Balkan Congress Center
09 ³⁰ - 10 ³⁰	Opening Ceremony Balkan Synphony Orchestra Slide Show: Sunflower from Soil to Table:Our Yellow Bride in the fields Giving Appreciation Certificates to our Sponsors
10 ³⁰ – 11 ⁰⁰	Coffee break
11 ⁰⁰ - 12 ³⁰	OPENING SESSION: Session Chair: PROF DR MARIA DUCA – Rector of University of Moldova Academy of Science
11 ⁰⁰ – 11 ⁴⁰	Invited Speaker Prof Dr. Dragan Skoric “HISTORY OF SUNFLOWER BREEDING IN THE WORLD”
11 ⁴⁰ – 12 ²⁰	Invited Speaker Dr. Lili Qi “MOLECULAR MAPPING OF THE DISEASE RESISTANCE GENES AND ITS IMPACT ON SUNFLOWER BREEDING”
12 ²⁰ – 12 ³⁰	DISCUSSION
12 ³⁰ – 13 ³⁰	LUNCH ((Courtesy of Nidera Semillas)

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	GENETIC AND BREEDING	BIOTIC AND ABIOTIC STRESS TOLERANCE	CROP PRODUCTION AND MANAGEMENT	MOLECULAR GENETICS
	(Main Meeting Room)	(2 nd Floor Senate Meeting Room)	(2 nd Floor Left Meeting Room)	(2 nd Floor Right Meeting Room)
	30.05.2016 MONDAY	30.05.2016 MONDAY	30.05.2016 MONDAY	30.05.2016 MONDAY
13 ³⁰ -15 ³⁰	<i>1st Session Chair: CARLOS FEOLI</i>	<i>1st Session Chair: DR MARIA JOITA- PACUREANU</i>	<i>1st Session Chair: DR VALENTINA ENCHEVA</i>	<i>1st Session Chair: DR RENATE HORN</i>
13 ³⁰ -13 ⁵⁰	Invited Speaker DR BRANISLAV DOZET	The genetics and evolution of solar tracking – B. BLACKMAN, S. HARMER	Use of polymer hydrogel in soil moisture conservation for sunflower cultivation in rainfed situations of Northern Karnataka, India: A case study – U. SHANWAD, B. CHITTAPUR, SHANKERGOUD I, B. DESAI, GOVINDAPPA MR., V. KULKARNI	The cultivated sunflower pan genome provides insights on the wild sources of introgressions and their role in breeding – S. HUBNER, E. ZIGLER, J.R. MANDEL, D. SWANEVELDER, P. VINCOURT, N. LANGLADE, J. M. BURKE, L. H. RIESEBERG
13 ⁵⁰ -14 ¹⁰	Contemporary Challenges in Sunflower Breeding	Impact of exogenously applied glycine betaine on physiological attributes of sunflower under drought stress- NOSHIN I., NADIA Z., N. BATOOL, Q. BANO	Determination of the yield and yield components performance of some sunflowers (<i>Helianthus annuus</i> L.) under rainfed conditions – I. DEMIR	Principal Component Analysis for Carbon Isotope Discrimination-Related Traits in Recombinant Inbred Lines of Sunflower – A. L. ADIREDDY, T. LAMAZE, P. GRIEU
14 ¹⁰ -14 ³⁰	Genetic analysis of seed yield related traits under optimum and limited irrigation in sunflower – M. GHAFARI	Rapid invitro screening of sunflower genotypes for moisture stress tolerance using PEG 6000 - SHANKERGOUD I., SHESHIAH K. C.	Appropriate nitrogen (N) and phosphorus (P) fertilizer regime for sunflower (<i>Helianthus annuus</i> L.) in the humid tropics – E. AKPOJOTOR, V. OLOWE	Molecular Studies of Sunflower Responses to Abiotic Stresses – I. TINDAS, R. I. AYTEKIN, S. ÇALIŞKAN
14 ³⁰ -14 ⁵⁰	Breeding for sunflower hybrids adapted to climate change: the SUNRISE collaborative and multi-disciplinary Project - LUBRANO-LAVADERA A.S., M. COQUE, MUNOS S., DEBAEKE P., MANGIN B., GOUZY J., KEPHALIACOS C., PIQUEMAL J., PINOCHET X.,	Exploring drought tolerance related traits in <i>Helianthus argophyllus</i> , <i>Helianthus annuus</i> and their hybrids – M. MUBASHAR HUSSAIN, M. KAUSAR, M. KHAN, P. MONNEVEUX	Interactive Effects of Different Intra-Row spacing and Nitrogen Levels on Yield and Yield Components of confectionery sunflower (<i>Helianthus annuus</i> L.) genotype (Alaca) Under Ankara conditions – S. DAY, O. KOLSARICI	Comparative assessment of androgenic response in sunflower (<i>Helianthus annuus</i>) – N. AKGUL, E. ÇABUK ŞAHİN, Y. AYDIN, A. ALTINKUT UNCUOĞLU, G. EVCI, A GÜREL

19th International Sunflower Conference, Edirne, Turkey, 2016

	LANGLADE N.			
14 ⁵⁰ -15 ⁰⁰	Discussion	Discussion	Discussion	Discussion
15 ⁰⁰ -15 ³⁰	Coffee break	Coffee break	Coffee break	Coffee break
15 ³⁰ -17 ⁰⁰	2nd Session: Chair: DR VLADIMIR MIKLIC	2nd Session: Chair: DR FELICITY VEAR	2nd Session Chair: PROF DR GIAN PAOLO VANNOZZI	2nd Session Chair: DR PHILIPPE DEBAEKE
15 ³⁰ -15 ⁵⁰	Assessment of sunflower germplasm selected for cold tolerance under autumn planting conditions in Morocco - HOUMANAT K., MAZOUZ H., EL FECHTALI M., NABLOUSSI A.	Invited Speaker PROF DR STEVAN MAŠIREVIĆ	Global change adaptation: what future for sunflower crops and products? A foresight study for oilseed chains at 2030 horizon – E. PILORGE, A. M. TREMBLAY, F. MUEL	Molecular and genetic aspects of sunflower defensive response to downy mildew - T. ŞESTACOVA, A.PORT, M. DUCA
15 ⁵⁰ -16 ¹⁰	Perspective and challenges to develop high yielding, disease resistant and oil quality sunflower hybrids in India - R.K.SHEORAN		Sunflower diseases research progress and management	Bioactivity and Phytochemical Evaluation of Sunflower (<i>Helianthus annuus</i> L.) Leaf Extract – Y. BIBI, A. QAYYUM, S. NISA
16 ¹⁰ -16 ³⁰	Stability performance of new introduced sunflower hybrids for seed yield and its components under Sudan conditions – A. A. M. ABDALLA	Control of Verticillium dahliae causing sunflower wilt using Brassica green manures - DESSERRE D., MESTRIES E., DECHAMP-GUILLAUME G., SEASSAU C.	Effects of Different Organomineral and Inorganic Compound Fertilizers on Seed Yield and Some Yield Components of Sunflower (<i>H. annuus</i> L.) – S. SUZER, E. CULHACI	Molecular Studies involved in sunflower responses in drought stress - I. ALTINDAS, E. AKSOY, S. CALISKAN
16 ³⁰ 16 ⁴⁵	Discussion	Discussion	Discussion	Discussion
16 ⁴⁵ -18 ⁰⁰	Poster Session	Poster Session	Poster Session	Poster Session
19 ³⁰ -	Dinner Party (Courtesy of Syngenta)	Dinner Party (Courtesy of Syngenta)	Dinner Party (Courtesy of Syngenta)	Dinner Party (Courtesy of Syngenta)

	31.05.2016 TUESDAY	31.05.2016 TUESDAY	31.05.2016 TUESDAY	31.05.2016 TUESDAY
09 ³⁰ -10 ¹⁰	3RD Session Chair: DR OLIVIER COTTET	3RD Session Chair: PROF DR STEVAN MASIREVIC	3RD Session Chair: DR AMELIA BERTERO DE ROMANO	3RD Session Chair: DR DRAGANA MILADINOVIC
09 ³⁰ -09 ⁵⁰	Collection of wild <i>Helianthus anomalus</i> and <i>deserticola</i> sunflower from the desert southwest USA – G. SEILER, L. MAREK	Isolation and identification of pathogen of Sunflower <i>Fusarium Wilt</i> - JING G. YUAN YUAN Z., GUI Z., JIAN Z., KAI W., JUN Z.	Invited Speaker	Proteomic response of sunflower to drought stress – M. GHAFARI, M. TOORCHI, M. VALIZADEH
09 ⁵⁰ -10 ¹⁰	The b1 locus that controls apical shoot branching in <i>H. annuus</i> exhibits a molecular diversity linked to the breeding history of hybrids - DURIEZ P., BONIFACE, M. C., POUILLY N., VAUTRIN S., MAYJ., RODDE N., BERGES H., CARRERE S., GOUZY J., P. VINCOURT, J. PIQUEMAL, S. MUNOS	Distribution of <i>Plasmopara halstedii</i> pathotypes in Hungary – R. BÁN, A. KOVÁCS, G. BAGLYAS, M. PERCZEL, G. TUROCZI, K. KOROSI	DR PHILIPPE DEBAEKE	Identification of HaDELLA, HaGID1 as well as HaSLEEPY and HaSNEEZY genes involved in gibberellin signaling in sunflower - R. EWALD, N. GEHM, L. POPIOLKOWSKI, A. ANTELMANN, R. HORN
10 ¹⁰ -10 ³⁰	Phenotypic and genotypic characterization of 400 new sunflower pre-bred lines – G. BAUTE, W. ANYANGA, E. ALBRECHT, L. H. RIESEBERG	Exploitation of the knowledge on oomycete effectors to drive the discovery of durable disease resistance to downy mildew in sunflower – Y. PECRIX, L. BUENDIA, Q. GASCUEL, C. PENOUILH-SUZETTE, L. GODIARD	Chemical Broomrape (<i>Orobanche cumana</i>) control in Clearfield® sunflower with different Imazamox containing herbicide formulations – M. PFENNING, M. VALTIN, S. SASCHA, J. BESSAI	Characterization of sunflower inbred lines with high oleic acid content by DNA markers – B. B. BILGEN
10 ³⁰ -10 ⁵⁰	Developing well adapted hybrids in Europe by using a G*E approach - GAUTIER F., HELOISE H., MILAGROS G., SAUVAIRE D.	Response to sunflower (<i>Helianthus annuus</i> L.) plant at early growth stage to cadmium toxicity – Y. CIKILI, H. SAMET, N. C. ATIKMEN	Pulsar® Plus and Eurolightning® Plus - herbicides for enhanced weed control in Clearfield® Plus sunflower – J. BESSAI, SCHLÄFER S., PFENNING M., MORAN D., CARTIN J.	Evaluation of WRKY and MYB transcription factors in some downy mildew infected sunflower lines; microarray data analysis – E. FILIZ, I. I. ÖZYİĞİT, R. VATANSEVER

10 ⁵⁰ -11 ⁰⁰	Discussion	Discussion	Discussion	Discussion
11 ⁰⁰ -11 ²⁰	Coffee break	Coffee break	Coffee break	Coffee break
11 ²⁰ -12 ³⁰	4th Session Chair: DR SINISA JOCIC	4th Session Chair: DR MICHAEL FOLEY	4th Session Chair: DR SUJATHA MULPURI	4th Session Chair: PROF DR RISHI BEHL
11 ²⁰ -11 ⁴⁰	Correlation studies between SSR marker based genetic distance and heterosis in sunflower (<i>Helianthus annuus</i> L.) – V. KULKARNI, SHANKERGOUD I., SUPRIYA S.M, SURESHA P.G.	PCR combined with GFP tagged <i>Verticillium dahliae</i> confirmed the seeds transmission of Sunflower <i>Verticillium</i> Wilt - YUAN YUAN Z., GUI Z., JIAN Z., JUN Z.	Relationships between Germination and Vigor Tests with Field Emergence of Sunflower in Iran – H. SADEGHI, S. SHEIDAEI	Invited Speaker DR STEPHANE MUNOS De novo sequencing of the <i>Helianthus annuus</i> and <i>Orobanche cumana</i> genomes
11 ⁴⁰ -12 ⁰⁰	Optimization of Agrobacterium-mediated gene transfer systems in Turkish sunflower (<i>Helianthus annuus</i> L.) varieties – I. I. ÖZYİĞİT, S. KARADENİZ, H. TOMBULOĞLU, E. FILİZ	Stability of the level of partial resistance to white rot in sunflower – M. ANABELLA DINON, F. CASTAÑO, S. SAN MARTINO, J. LÚQUEZ, F. QUIROZ	Pest Monitoring and Handling System Based on 4G Mobile System – C. ATLIĞ	
12 ⁰⁰ -12 ²⁰	Inclusion of dominance effect in genomic selection model to improve predictive ability for sunflower hybrid performance – F. BONNAFOUS, N. LANGLADE, B. MANGIN	Genetic divergence among sunflower inbred lines and their convergent improvement for yield, quality and disease resistance- R. RANI - R. K. SHEORAN – S. CHANDER – R. K. BEHL	New seed treatment solutions for <i>Plasmospora</i> Resistance Management in Sunflower – F. BRANDL	Comparison of cytoplasmic male sterility based on PET1 and PET2 cytoplasm in sunflower (<i>Helianthus annuus</i> L.) - HORN R., REDDEMANN A., DRUMEVA M
12 ²⁰ -12 ³⁰	Discussion	Discussion	Discussion	Discussion
13 ³⁰ -13 ³⁰	Lunch (Courtesy of Edirne Farmer Union)	Lunch (Courtesy of Edirne Farmer Union)	Lunch (Courtesy of Edirne Farmer Union)	Lunch (Courtesy of Edirne Farmer Union)
13 ³⁰ -15 ³⁰	5th Session Chair: DR THIERRY ANDRE	5th Session Chair: DR ROBERT NEMETH	5th Session Chair: PROF DR BENJAMIN BLACKMAN	5th Session Chair: PROF DR DEJANA PANKOVIC
13 ³⁰ -13 ⁵⁰	Invited Speaker DR MARIA JOITA-PACUREANU Broomrape (<i>Orobanche cumana</i> Wallr.) - Update on racial	Cadmium-potassium interrelationships in sunflower (<i>Helianthus annuus</i> L.) – H. SAMET, Y. CIKILI, N. C. ATIKMEN	Performance of sunflower hybrids in black cotton soils of Northern Karnataka, India – U. SHANWAD, SHANKERGOUD I, S. N. SUDHAKARBABU, V. KULKARNI, GOVINDAPPA MR, VIJAYKUMAR G.	Approaches for improvement of resistance to powdery mildew in sunflower (<i>Helianthus annuus</i> L.) – S. MULPURI, K. PALCHAMY, C. R. SANKARANENI, V. KODEBOYİNA

13 ⁵⁰ -14 ₁₀	composition and distribution, host resistance and management	Effects of Micro Nutrients (Fe, Zn, B and Mn) on Yield and Yield Components of Two Sunflower (<i>Helianthus annuus</i> L.) Cultivars in Urmia Condition – A. RAHIMI, J. JALILIAN	Modeling sunflower fungal complex to help design integrated pest management strategies - AUBERTOT J. N., MESTRIES E., M. A. VEDY-ZECCHINI, P. DEBAEKE	Genetic engineering studies on sunflower- M. E. ÇALIŞKAN, S. DAS DANGOL
14 ¹⁰ -14 ₃₀	Testing annual wild sunflower species for resistance to <i>Orobanche cumana</i> Wallr – S. TERZIĆ, B. DEDIĆ, J. ATLAGIĆ, S. JOCIĆ, D. MILADINOVIĆ, M. JOCKOVIĆ	Quantification of drought tolerance levels of sunflower inbred lines by means of <i>chlorophyll</i> -a fluorescence - A. S. BALKAN, NALCAIYI, S. CULHA ERDAL - O. GUNDUZ, V. PEKCAN, O. ARSLAN, N. CICEK, Y. KAYA, Y. EKMEKCI	Escape to tiny bug (<i>Nysius simulans</i> Stål) attack across planting date adjustment in sunflower hybrid seed crops from southern BuenosAires province, Argentine – J. RENZI, O. REINOSO, M. BRUNA, M. AVALOS, M. CANTAMUTTO	Invited Speaker DR NICOLAS LANGLADE Genome-wide association of oil yield plasticity to drought, nitrogen and chilling stresses in sunflower
14 ³⁰ -14 ₅₀	Determination of superior hybrid combinations in sunflower and testing of their resistance to broomrape (<i>Orobanche cumana</i> Wallr.) In infested areas – O. GÜNDÜZ, A. T. GOKSOY	The effect of climate factors and climate change on the yield of sunflower (<i>Helianthus annuus</i> L.) in Marmara region – H. GURKAN, H. BULUT, N. BAYRAKTAR, M. DEMIRCAN, O. ESKIOĞLU, N. KOÇAK	Current Situation, Problems and Solutions of Sunflower in the Central Anatolian Region – C. YAVUZ, S. CALISKAN	
14 ⁵⁰ -15 ₀₀	Discussion	Discussion	Discussion	Discussion
15 ⁰⁰ -15 ₃₀	Coffee break	Coffee break	Coffee break	Coffee break
15 ³⁰ -17 ₀₀	6th Session Chair: DR CHAO CHIEN JAN	6th Session: Chair: DR GERALD SEILER	6th Session Chair: PROF DR MICHELLE GILLEY	6th Session Chair: DR STEPHANE MUNOS
15 ³⁰ -15 ₅₀	Invited Speaker DR GORAN MALIDZA	Effects of Naphthalene Acetic Acid and N6-Benzyladenine on Androgenesis in <i>Helianthus annuus</i> L. Anthers - S. DAYAN, H. ARDA	Microbial Dressing of Sunflower Seeds with <i>Trichoderma harzianum</i> KUEN 1585 – Y. S. YONSEL, M. SEVİM	QTL mapping for broomrape (<i>Orobanche cumana</i> Wallr.) resistance in sunflower – I. CELİK, D. ZARARSIZ, A. FRARY, S. DOGANLAR
15 ⁵⁰ -16 ₁₀	Integrated weed management in sunflower: Challenges and opportunities	Do cell wall proteins affect the setting of grains and their potential weight in sunflower? – D. CALDERINI, S. VASQUEZ, F. CASTILLO, P.	Green and brown bridges aid survival of multiple <i>Diaporthe</i> / <i>Phomopsis</i> species with a range of virulences on sunflower, soybeans,	Determination the genetic characterization of different lines of sunflower (<i>Helianthus annuus</i> L.) by using genetic resources

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		MONTECINOS, A. CLAUDE, C. LIZANA, R. RIEGEL	mungbeans and other crops in Australia. – S. THOMPSON, S. NEATE, Y. PEI TAN, R. SHIVAS, E. AITKEN	based on SSRs (Simple Sequence Repeat) – D. BASALMA, M. PASHAZADEH
16 ¹⁰ -16 ³⁰	Advancements in Clearfield® Plus Sunflower Hybrid Variety Development – B. WESTON, M. PFENNING, C. NIETO, P. ANGELETTI, E. SAKIMA	The Estimating Drought Stress Tolerances of Sunflower Inbred lines under controlled environmental conditions – O. ARSLAN, A. S. BALKAN NALCAIYI, G. EVCI, V. PEKCAN, I. M. YILMAZ, S. ÇULHA ERDAL, N. CICEK, Y. KAYA, Y. EKMEKCI	Evaluation of Sunflower (<i>Helianthus annuus</i> L.) Hybrids for Photothermal Units Accumulation, Oil Yield, Oil Quality and Yield Traits under Spring Planting Conditions of Haripur, Pakistan – A. QAYYUM, I. SULTAN, S. U. KHAN, Y. BIBI, A. MEHMOOD, A. SHER, M. A. JENKS	Study of the genomic diversity of <i>Verticillium sp.</i> capable of colonizing sunflower. How knowledge of pathogen genetic structure can be combined with classical breeding approaches to guide it – H. MISSONNIER, F. LUIGI, L. GWENAELE, DAYDÉ J, J. ALBAN, THOMMA B. PHJ
16 ³⁰ -16 ⁴⁵	Discussion	Discussion	Discussion	Discussion
16 ⁴⁵ -18 ⁰⁰	Poster Session	Poster Session	Poster Session	Poster Session
19 ³⁰ -	Dinner Party	Dinner Party	Dinner Party	Dinner Party
	01. 06.2016 WEDNESDAY	01. 06.2016 WEDNESDAY	01. 06.2016 WEDNESDAY	01. 06.2016 WEDNESDAY
09 ³⁰ -11 ⁰⁰	7th Session Chair: DR MIGUEL CANTAMUTTO	REGISTRATION		
09 ³⁰ -09 ⁵⁰	The effects of applied herbicides on yield and oil quality components of two oleic and two linoleic sunflower (<i>Helianthus annuus</i> L.) hybrids – F. ONEMLI, U. TETIK	INTERNATIONAL SUNFLOWER OIL QUALITY SYMPOSIUM Opening Ceremony		
09 ⁵⁰ -10 ¹⁰	New virulences of <i>Orobanche cumana</i> appear in Romania - PARVU N., TEODORESCU A.	Session Chair: PROF DR MEHMET EMIN CALISKAN Invited Speaker Fabrice THURON - "HO Oilseeds and Oils Market: Positioning Sunflower Today and Tomorrow"		
10 ¹⁰ -10 ³⁰	Genetic characterization of the interaction between sunflower and <i>Orobanche cumana</i> - LOUARN J., M. C. BONIFACE, POUILLY N., VELASCO L., P. VINCOURT, B.	Invited Speaker Prof Dr Nurhan TURGUT DUNFORD Sunflower Oil: A Premium Oil for Food Applications		

	PÉREZ-VICH, MUNOS S.		
10 ³⁰ -10 ⁵⁰	Study of <i>Orobanche cumana</i> genetic diversity – M. COQUE, T. ANDRE, R. GIMENEZ, M. ARCHIPIANO, L. POLOVYNKO, M. C. TARDIN, C. JESTIN, B. GREZES-BESSET	Invited Speaker DR. LEONARDO VELASCO Source and sink affect phytosterol concentration and composition of sunflower oil	
10 ⁵⁰ -11 ⁰⁰	Discussion	Discussion	Discussion
11 ⁰⁰ -11 ²⁰	Coffee break	Coffee break	Coffee break
11 ²⁰ -12 ³⁰	8th Session: Chair: DR LOREN H. RIESEBERG	8th Session: Chair: DR LEONARDO VELASCO	8th Session: Chair: PROF DR ZHAO JUN
11 ²⁰ -11 ⁴⁰	Invited Speaker DR LAURA F. MAREK	Oil content and oil quality characteristics of linoleic and high-oleic sunflower varieties cultivated in Turkey – B. ASKIN, M. AFACAN, V. BİCER, Ö. KARADAS, İ. KONUK	Quality characteristics of roasted sunflower seeds during storage - M. B. BAHAR, F. SEYHAN, B. OZTURK, B. TOPAL, F. S. BAYRAKTAR
11 ⁴⁰ -12 ⁰⁰	Sunflower Genetic Resources	Determination of Textural, Rheological Properties and SFC, SMP Values of Oleogels Prepared Using Sunflower Oil – H. PEHLİVANOĞLU, O. S. TOKER, H. IMAMOĞLU, M DEMIRCI	Effect of different storage conditions on quality properties of raw and roasted sunflower kernels – F. SEYHAN, M. B. BAHAR, B. TOPAL, B. ÖZTÜRK, F. S. BAYRAKTAR
12 ⁰⁰ -12 ²⁰	Four decades of sunflower genetic resources activities in India – M. DUDHE, S. MULPURI	Assessment of sunflower oil adulteration – A. CEVIK, A. UNVER	The Evaluation of Sunflower Harvest Waste as Silage Feed – S. BUYUKKILIC BEYZI, M. YILMAZ, Y. KONCA
12 ²⁰ -12 ³⁰	Discussion	Discussion	Discussion
12 ³⁰ -13 ³⁰	Lunch (Courtesy of Edirne Commodity Exchange)		
13 ³⁰ -15 ³⁰	9th Session Chair: DR ABELARDO DE LA VEGA	9th Session Chair: PROF DR NURHAN T. DUNFORD	9th Session Chair: PROF DR SEVGI CALISKAN
13 ³⁰ -13 ⁵⁰	Invited Speaker DR NADA HLADNI	The effects of vacuum and atmospheric deep-fat frying process on total frying-use time of sunflower oil and on french fries quality – E. DEVSEREN, D. TOMRUK, U. BAYSAN, M. KOC, H. KARATAŞ, F. ERTEKIN	Study of the characteristics of cultivated varieties of sunflower, regarding the production of high quality sunflower meal with dehulling process - S. DAUGUET, F. LABALETTE, F. FINE, P. CARRE, A.MERRIEN, J. P. PALLEAU
13 ⁵⁰ -14 ¹⁰	Present status and future prospects of global confectionery sunflower production	Effect of curcumin nanoparticles on oxidative stability of sunflower oil-in-water emulsions – F. BOZKURT, M. T. YILMAZ, C. YILDIRIM	Acceptability of chapati Made With Supplementation of Sunflower (<i>Helianthus annuus</i> L.) Seed Meal – M. KARWASRA, S. DHIYA

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14 ¹⁰ -14 ³⁰	Grain, kernel and hull characterization of oilseed and oilseed x confectionary genotypes- S. ZUIL, M. LAUREANO, P. ROCCA, M. DELLA MADDALENA	Application of artificial neural network on prediction of moisture content of the deep-fat frying of beef meatballs in sunflower oil-H.I. KOZAN, C. SARIÇOBAN, H. AKYÜREK	Some Antinutrients and in vitro Protein Digestibility of Home Processed Sunflower Seed Meal – M. KARWASRA, S. DHIYA
14 ³⁰ -14 ⁵⁰	Effects of herbicide and salinity stresses on some defense responses of sunflower plant- A. KAYA	Effect of the Deep-Fat Frying Process on Aroma Compounds of Sunflower Seed Oil – S. KESEN, A. S. SÖNMEZDAĞ, A. AMANPOUR, H. KELEBEK, S. SELLI	
14 ⁵⁰ -5 ⁰⁰	Discussion	Discussion	Discussion
15 ⁰⁰ -15 ³⁰	Coffee break	Coffee break	Coffee break
15 ³⁰ -17 ⁰⁰	10th Session Chair: DR PIERRE CASADEBEIG	10th Session Chair: DR SUSAN THOMPSON	10th Session Chair: DR NICOLAS LANGLADE
15 ³⁰ -15 ⁵⁰	Quantitative Determination of Sunflower in Mixed Concentrate Feeds by Real Time PCR- M. KAYA,Z. KIYMA	The Effect of the ESSENTIAL OIL from <i>Citrus aurantium</i> as a source of natural antioxidant in sunflower oil – O. ERDOĞDU, A. BOZDOGAN	The Meeting of International Consortium for Sunflower Genomic Resources
15 ⁵⁰ -16 ¹⁰	The evaluation of annual wild <i>Helianthus</i> species for their morphological, phenological and seed chemical characteristics in field conditions – F. ONEMLI, G. ONEMLI	LC-DAD/ESI-MS/MS Characterization of Phenolic Compounds of Sunflower oil – H. KELEBEK, S. SELLI, A. S. SÖNMEZDAĞ, S. KESEN, G. GUCLU, O. KOLA	
16 ¹⁰ -16 ³⁰		Lessons from ten years of an interprofessional survey plan on sunflower food safety - S. DAUGUET, F. LACOSTE	
16 ³⁰ -16 ⁴⁵	Discussion	Discussion	

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16 ⁴⁵ -17 ⁴⁵	ISA GENERAL ASSEMBLY
17 ⁴⁵ -18 ⁰⁰	<i>Closing Ceremony</i>
19 ³⁰ -23 ³⁰	GALA DINNER

	02.06.2016 THURSDAY
09 ³⁰ -12 ⁰⁰	Field Day in Trakya Agricultural Research Institute Visiting Demo Plots
12 ⁰⁰ -13 ⁰⁰	Lunch
13 ³⁰ -17 ³⁰	Edirne City Tour
17 ³⁰ -	Free Shopping Time

	03.06.2016 FRIDAY
07 ⁰⁰ -19 ³⁰	Istanbul City Tour
19 ³⁰ -23 ³⁰	Bosphorus Yacht Tour and Dinner

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THE EFFECT OF SOWING DATE AND DENSITY ON CALLUS INDUCTION AND SHOOT REGENERATION FROM SUNFLOWER ANTHERS

Dragana MILADINOVIĆ¹, Branislav KOVAČEVIĆ², Siniša JOCIĆ¹, Ivana IMEROVSKI¹, Aleksandra DIMITRIJEVIĆ¹, Sandra CVEJIC¹, Igor BALALIĆ¹*

¹*Institute of Field and Vegetable Crops, Maksima Gorkog 30, 21000 Novi Sad, Serbia*

²*University of Novi Sad, Institute of Lowland Forestry and Environment, Antona Čehova 13, 21000 Novi Sad, Serbia*

**dragana.miladinovic@ifvcns.ns.ac.rs*

ABSTRACT

The success of anther culture depends on numerous factors such as genotype, donor plant growing conditions, anther pre-treatment and development stage, as well as incubation conditions. We have investigated the effect of sowing date and sowing density of donor plants on callus induction and shoot regeneration from cultivated sunflower anthers. Anthers were collected from three commercial sunflower hybrids that were sown in four different sowing dates, and at three different sowing densities. Anthers were surface sterilized and placed on MS-medium based solid regeneration media. The appearance of organogenesis or somatic embryogenesis was observed and obtained data statistically analysed. The experiment was set as completely randomised, with two factors. Callus, somatic embryo, shoot and root regeneration on the anthers of the tested genotypes was observed. Data were analysed by ANOVA. Statistical analysis enabled us to determine effect of sowing date and density on anther culture and shoot regeneration induction. Sowing date had a significant effect on all observed parameters, with earlier sowing dates having significant positive effect on shoot regeneration. Sowing density had no effect on either of observed parameters in all tested genotypes. The obtained results will contribute to the better understanding of the conditions needed for haploid production in sunflower and its introduction in sunflower breeding programs.

Key words: Anther culture, Dihaploid, Donor plant, Regeneration, Sunflower

INTRODUCTION

Anther culture results in sunflower (*Helianthus annuus* L.) have been rather unsatisfactory up to now (Marinković et al., 2003). As in other species, anther culture response of sunflower is strongly affected by numerous factors such as genotype, donor plant growing conditions, anther pre-treatment and development stage, as well as incubation conditions (Gurel et al, 1991; Miladinović et al, 2012). By testing a number of different parameters, that is, donor plant growing conditions and stages, as well as culture media and conditions, appropriate protocol could be worked out for the successful regeneration of shoots - at least for a number of genotypes.

Various environmental factors that the donor plants are exposed to may affect haploid plant production. Light intensity, photoperiod, and temperature have been investigated, and at least for some species, these are found to influence the number of plants produced from anther cultures (Reed, 2005). Seasonal variations have been reported to influence anther response in *Triticum aestivum* (Ouyang et al., 1987) and *Solanum tuberosum* (Tiainen, 1992), while different temperature regimes were found to affect anther response in wheat hybrid plants

(Orshinsky and Sadasivaiah, 1997). Growing season and conditions, as well as donor plant age had an effect on anther culture of *Capsicum annuum* (Ercan et al., 2006; Buyukalaca et al., 2004).

Up to our knowledge, there are no reports on effect of donor plant growing conditions on sunflower anther culture. There are only reports on influence of medium composition variation on the frequency of anther callusing and/or somatic embryogenesis and subsequent plant regeneration (Marinković et al., 2003; Miladinović et al., 2012). Different compositions of media used for establishing anther culture were extensively reviewed by Friedt et al. (1997), and variation of other culture parameters by Nichterlein and Horn (2005).

We have investigated the effect of sowing date and sowing density of donor plants on callus induction and shoot regeneration from cultivated sunflower anthers.

MATERIAL AND METHODS

Anthers were collected from three commercial sunflower hybrids (NS Oskar, NS Fantazija, and Orfej). The hybrids were sown in four different sowing dates and at three different sowing densities (30,000; 50,000 and 70,000 plants per ha).

After collection, anthers were surface sterilized and placed on solid regeneration media, supplemented with basic MS macro and micro salts (Murashige and Skoog, 1962), 0.3% gelrite, pH 5.7, while composition of hormones varied (Vasić et al., 2000; Miladinović et al., 2012). Anthers were cultured in the dark at 30°C.

Two experiments were set as completely randomized, with two factors. In the first experiment factors were sowing date and genotype of donor plants, while in the second experiment factors were sowing density and genotype. Callus, somatic embryo, shoot, root and plant regeneration on the anthers of the tested genotypes was observed. The data were transformed by *arc sine* transformation in order to obtain normal distribution of their frequencies, which is required for further statistical analysis. Analysis of variance and Fisher's least significant difference test were performed in statistical program STATISTICA 12.0 (StatSoft Inc., 2013) in order to establish the significance of factor effects and their interaction, and significance of difference among treatments. Based on results of ANOVA, in order to estimate the relative importance of examined sources of variance, expected variances and their contribution to the total variance were calculated.

RESULTS AND DISCUSSION

Sowing date

Regarding contribution of components of variance to the total variance, sowing date had the highest effect on root regeneration since its variance contributed to over 50% of total variance (Figure 1). It also had the strongest effect on callus formation, as well as shoot and plant regeneration, contributing to 45%, 20% and 15% of the total variance, respectively. The effect of sowing date and interaction was similar for embryo formation, as their variances contributed approximately to 25% of total variance, each.

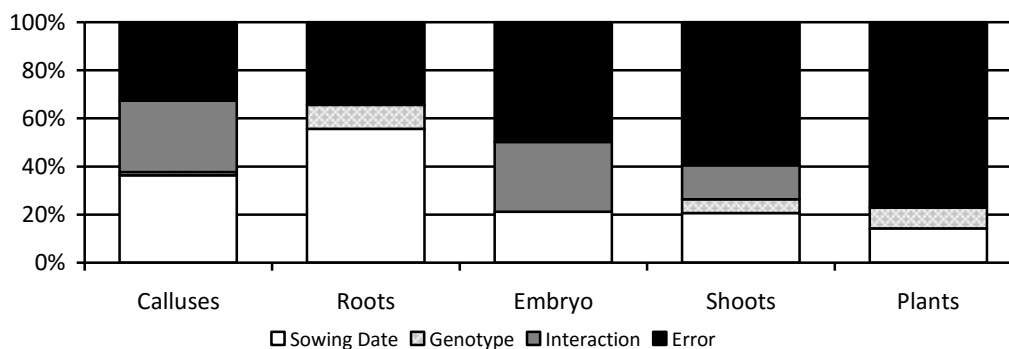


Figure 1. Contribution of expected variances of tested variation sources to the total variance (%)

Although sowing date significantly affected only plant regeneration, LSD test showed that earlier sowing dates had more positive effect on all observed parameters (Table 1). This especially stands for shoot and plant regeneration, as there were no regenerants from anthers collected at later sowing dates. Anthers collected from the plants sown at the earliest planting date had the best androgenic response, as they formed the highest number of calluses and embryos, and had the highest percentage of regeneration of roots, shoots and plants. Genotype had significant effect on shoot and plant regeneration. LSD test indicated that there was no significant difference among tested hybrids for embryo formation.

Table 1. LSD test for percentage of callusogenesis, somatic embryogenesis, root, shoot and plant regeneration at different sowing dates

	Calluses	Roots	Embryos	Shoots	Plants	
Date	p	p	p	p	p	
	0.000	0.000	0.000	0.009	0.071	
Genotype	0.027	0.025	0.025	0.606	0.119	
Date*Genotype	0.009	0.562	0.562	0.035	0.448	
Variant	Genotype					
DATE I	86.809a	27.898a	1.612a	0.974a	0.374a	
DATE II	83.351a	32.995a	0.784a	0.244ab	0.042ab	
DATE III	48.322b	8.441b	1.008a	0.000b	0.000b	
DATE IV	52.103b	2.950b	0.014b	0.000b	0.000b	
	OSKAR	79.006a	24.313a	0.747a	0.000b	0.000b
	FANTAZIJA	70.243ab	10.526b	0.868a	0.457a	0.211a
	ORFEJ	56.924b	13.811b	0.442a	0.189ab	0.023ab

The values within the same column marked with different letters differed significantly at $\alpha_{0.05}$

Sowing density

Sowing density did not have any effect on the observed parameters (Figure 2). Genotype had the strongest effect on callus formation, as it contributed to 55% of total variance. Embryo formation was equally influenced by genotype and interaction (25% of total variance, each) while interaction had the highest effect on root regeneration (20% of total variance).

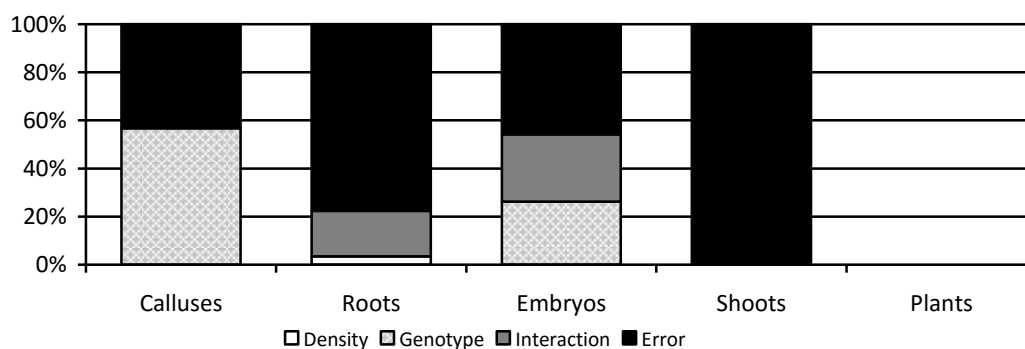


Figure 2. Contribution of expected variances of tested variation sources to the total variance (%)

Analysis of variance showed that sowing density generally had significant effect on tested parameters, but that there were no significant differences among different densities (Table 2). Interaction was significant for all tested traits, while genotype had significant effect on root and shoot formation.

Table 2. LSD test for percentage of callusogenesis, somatic embryogenesis, root, shoot and plant regeneration at different sowing densities

	Calluses	Roots	Embryos	Shoots	Plants*	
	p	p	p	p	p	
Density	0.428	0.273	0.863	0.387	-	
Genotype	0.000	0.816	0.003	0.387	-	
Density*Genotype	0.961	0.186	0.055	0.433	-	
Variant	Genotype					
30,000	78.057a	19.743a	0.510a	0.000a	-	
50,000	70.928a	17.376a	0.694a	0.000a	-	
70,000	78.131a	22.920a	0.420a	0.042a	-	
	OSKAR	70.408b	19.419a	0.355b	0.000a	-
	FANTAZIJA	63.339b	21.206a	2.182a	0.000a	-
	ORFEJ	90.220a	19.291a	0.014b	0.042a	-

The values within the same column marked with different letters differed significantly at $\alpha_{0.05}$
 *This parameter did not vary in some variants, so it was not possible to do variance analysis.

In our study, we have found that sowing date had an effect on establishment and plant regeneration from sunflower anther culture. Higher regeneration frequencies were obtained with plants from earlier sowing dates. The prevailing temperature during the growth of donor plants is reported to play a crucial role in microspore embryogenesis in Crucifers (Pratap et al., 2009). A high frequency of embryogenesis was consistently obtained in donor plants grown at low temperatures (Keller et al., 1987; Dunwell et al., 1985). This could be the reason for better regeneration frequencies in earlier sowing dates in our experiment, as low temperature is thought to increase the number of microspores suitable for embryogenesis due to slow pollen development, and it also prolongs the duration for which suitable microspores are available in a crop (Pratap et al., 2009). The opposite results were observed in wheat anther culture where embryo regeneration was usually greater when anthers were obtained from plants grown at high temperatures than plants grown at lower temperatures (Orshinsky and Sadasivaiah, 1997).

The lack of effect of sowing density on the observed parameters indicates that in our experiment irradiation and the temperature within the canopy were not important for androgenic response in tested hybrids, and that sowing date and temperature conditions during the plant growth have greater effect on this trait.

The results obtained in our study indicate that although genotype plays an important role in sunflower anther culture, the regeneration frequency could be improved by taking care of growing conditions of donor plant. Future studies should be focused on further optimisation of donor plants growing conditions in order to minimize genotype effect and sunflower androgenic potential and enable creation of the environment that will favour haploid plant regeneration.

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