19TH INTERNATIONAL SUNFLOWER CONFERENCE

TRAKYA ÜNİVERSİTESİ 1982

ISC 2016

29 MAY – 3 JUNE, 2016

EDIRNE, TURKEY

ISC 2016

PROCEEEDINGS
OF
19TH INTERNATIONAL SUNFLOWER CONFERENCE

29 MAY – 3 JUNE, 2016

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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

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SESSIONS	SPEAKER
Breeding	Dr Branislav DOZET (Hungary)
Molecular Breeding	Dr. Lili QI (USA)
Agronomy and Seed Production	Dr Philippe DEBAEKE (France)
Genetic Resources	Dr Laura MAREK (USA)
Disease & Pest resistance and Management	Prof Dr Steven MASIREVIC (Serbia)
Orobanche Resistance and Management	Dr Maria JOITA-PACUREANU (Romania)
Abiotic Stress Tolerance and Management	Dr Nicolas LANGLADE (France)
Herbicide Resistance and Management	Dr Goran MALIDZA (Serbia)
Confectionery	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 & Associes,	FRANCE
Dr Leanordo VELASCO	CSIC, Cordoba,	SPAIN

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19TH INTERNATIONAL SUNFLOWER CONFERENCE
29 MAY – 3 JUNE, 2016
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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 Certficates 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 Qİ "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)**

	GENETIC AND BREEDING	BIOTIC AND ABIOTIC STRESS TOLERANCE	CROP PRODUCTION AND MANAGEMENT	MOLECULAR GENETICS
	(Main Meeting Room)	**(2nd Floor Senate Meeting Room)**	**(2nd Floor Left Meeting Room)**	**(2nd Floor Right Meeting Room)**
30.05.2016 MONDAY		**30.05.2016 MONDAY**	**30.05.2016 MONDAY**	**30.05.2016 MONDAY**
13^{30} -15^{30}	***1st Session Chair: CARLOS FEOLI***	***1st Session Chair: DR MARIA JOITA- PACUREANU***	***1stSession Chair:DR VALENTINA ENCHEVA***	***1stSession Chair: DR RENATE HORN***
13^{30} -13^{50}	***Invited Speaker*** **DR BRANISLAV DOZET** Contemporary Challenges in Sunflower Breeding	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, GOVİNDAPPA 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}		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 (*Helianthus annuus* L.) under rainfed conditions – I. DEMIR	Principal Component Analysis for Carbon Isotope Discrimination-Related Traits in Recombinant Inbred Lines of Sunflower – A. L. ADIREDJO, T. LAMAZE, P. GRIEU
14^{10} -14^{30}	Genetic analysis of seed yield related traits under optimum and limited irrigation in sunflower – M. GHAFFARI	Rapid invitro screening of sunflower genotypes for moisture stress tolerance using PEG 6000 - SHANKERGOUD I., SHESHAIAH K. C.	Appropriate nitrogen (N) and phosphorus (P) fertilizer regime for sunflower (Helianthus annuus 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., KEPHALİACOS C., PIQUEMAL J., PINOCHET X.,	Exploring drought tolerance related traits in *Helianthus argophyllus*, *Helianthus annuus* 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 Compenents of confectionery sunflower (*Helianthus annuus* L.) genotype (Alaca) Under Ankara conditions – S. DAY, O. KOLSARICI	Comparative assessment of androgenic response in sunflower (*Helianthus annus*) – N. AKGUL, E. ÇABUK ŞAHIN, Y. AYDIN, A. ALTINKUT UNCUOGLU, G. EVCI, A GÜREL

	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** Sunflower diseases research progress and management	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. ȘESTACOVA, 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		Bioactivity and Phytochemical Evaluation of Sunflower (*Helianthus annuus* L.) Leaf Extract – Y. BIBI, A. QAYYUM, S. NISA	Recent Molecular Studies on Downy Mildew Disease – A. K. TURKMEN, S. CALISKAN
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 (*H. annuus* L.) – S. SUZER, E. CULHACI	Molecular Studies involved in sunflower responses in drought stres - 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 *Helianthus anomalus* and *deserticola* sunflower from the desert southwest USA – G. SEILER, L. MAREK	Isolation and identification of pathogen of Sunflower *Fusarium* Wilt - JING G. YUAN YUAN Z., GUİ Z., JİAN Z., KAİ W., JUN Z.	***Invited Speaker*** **DR PHILIPPE DEBAEKE** Sunflower and climate change in Europe: crop vulnerability, adaptation, and mitigation potential	Proteomic response of sunflower to drought stres – M. GHAFFARI, M. TOORCHI, M. VALIZADEH
09^{50} -10^{10}	The b1 locus that controls apical shoot branching in *H. annuus* 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 *Plasmopara halstedii* pathotypes in Hungary – R. BÁN, A. KOVÁCS, G. BAGLYAS, M. PERCZEL, G. TUROCZI, K. KOROSI		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 (*Orobanche cumana*) 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 (*Helianthus annuus* 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. BESSAİ, 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 (*Helianthus annuus* L.) – V. KULKARNI, SHANKERGOUD I., SUPRIYA S.M, SURESHA P.G.	PCR combined with GFP tagged *Verticillium dahliae* confirmed the seeds transmission of Sunflower *Verticillium* 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 *Helianthus annuus* and *Orobanche cumana* genomes
11^{40}-12^{00}	Optimization of Agrobacterium-mediated gene transfer systems in Turkish sunflower (*Helianthus annuus* L.) varieties – I. I. ÖZYİĞİT, S. KARADENIZ, H. TOMBULOGLU, E. FILIZ	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. ATLIG	
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 *Plasmospora* Resistance Management in Sunflower – F. BRANDL	Comparison of cytoplasmic male sterility based on PET1 and PET2 cytoplasm in sunflower (*Helianthus annuus* 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 (*Orobanche cumana* Wallr.) - Update on racial	Cadmium-potassium interrelationships in sunflower (*Helianthus annuus* 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 (*Helianthus annuus* 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 (*Helianthus annuus* 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 *Orobanche cumana* 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 *chlorophyll*-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 (*Nysius simulans* 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 (*Orobanche cumana* Wallr.) In infested areas – O. GÜNDÜZ, A. T. GOKSOY	The effect of climate factors and climate change on the yield of sunflower (*Helianthus annuus* L.) in Marmara region – H. GURKAN, H. BULUT, N. BAYRAKTAR, M. DEMIRCAN, O. ESKİOĞLU, 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** Integrated weed management in sunflower: Challenges and opportunities	Effects of Naphthalene Acetic Acid and N6-Benzyladenine on Androgenesis in *Helianthus annuus* L. Anthers - S. DAYAN, H. ARDA	Microbial Dressing of Sunflower Seeds with *Trichoderma harzianum* KUEN 1585 – Y. S. YONSEL, M. SEVİM	QTL mapping for broomrape (*Orobanche cumana* Wallr.) resistance in sunflower – I. CELİK, D. ZARARSIZ, A. FRARY, S. DOGANLAR
15^{50} -16^{10}		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 *Diaporthe / Phomopsis* species with a range of virulences on sunflower, soybeans,	Determination the genetic characterization of different lines of sunflower (*Helianthus annuus* l.)by using genetic resources

		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 (*Helianthus annuus* 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 *Verticillium sp*. 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. GWENAELLE, 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**
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 (*Helianthus annuus* L.) hybrids – F. ONEMLI, U. TETIK	***INTERNATIONAL SUNFLOWER OIL QUALITY SYMPOSIUM*** Opening Cerenomy	
09 [50]-10[10]	New virulences of *Orobanche cumana* 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 *Orobanche cumana* - 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	

	PÈREZ-VICH, MUNOS S.		
10^{30}-10 ^{50}	Study of *Orobanche cumana* 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** Sunflower Genetic Resources	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}		Determination of Textural, Rheological Properties and SFC, SMP Values of Oleogels Prepared Using Sunflower Oil – H. PEHLİVANOGLU, O. S. TOKER, H. IMAMOGLU, 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** Present status and future prospects of global confectionery sunflower production	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}		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 (*Helianthus annuus* L.) Seed Meal – M. KARWASRA, S. DHIYA

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 C*itrus aurantium* 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 *Helianthus* 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	

16^{45}-17^{45}	**ISA GENERAL ASSEMBLY**
17^{45} -18^{00}	***Closing Ceremony***
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

CONTENTS

SCREENING OF THE PRESENCE OF OL GENE IN NS SUNFLOWER COLLECTION

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ABSTRACT

Providing high quality oil is of great interest for oil companies. When it comes to sunflower oil, there are two types of oil on the market: high linoleic and high oleic. High oleic oil is considered a healthier version of oil, since it rich in omega-9 fatty acids that are oxidative more stable than linoleic fatty acid (omega-6 fatty acid), dominant in common sunflower oil. Development of high oleic sunflower genotypes was enabled by the discovery of Pervenets mutant sunflower population. In the IFVCNS, there is a great collection of sunflower inbred lines with wide range of oleic acid content (OAC). From the collection, we have chosen 62 genotypes for determination of OAC. In addition we used molecular marker reported by Schuppert et al. (2006) to screen for presence of the mutation that led to increase in OAC. The OAC in lines in which the presence of the mutation was detected ranged between 36.48 and 88.61% (mutant lines derived from high oleic line L31 – 36.48 – 56.58 and standard inbred lines 58.25 – 88.61%); while in lines where OAC varied between 14.24 and 34.46% this mutation was not detected. These results will help in choosing the best parental lines in future breeding programs, while the marker used will enable quick detection of the mutation. In addition it showed that the mutation in mutant lines most likely did not affect the analyzed part of the FAD2-1D sequence.
Key words: Oleic acid, Helinathus annuus L., marker assisted selection

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is the third most important oilcrop in the world. Sunflower oil is naturally rich in polyunsaturated omega-6 fatty acid, linonelic acid, ranging between 50 and 70%, while the content of monounsaturated omega-9 fatty acid, oleic acid, ranges between 20 and 25% (Kabbaj et al., 1996). The creation of mutant sunflower cultivar Pervenets (Soldatov, 1976), obtained by dimethyl-sulfate (DMS) treatment lead to broadening of sunflower breeding programs and allowed creation of high oleic sunflower lines and hybrids. Today, the end user is dictating what type of oil is in high demand. Therefore, breeders create and conduct their breeding programs in compliance with the market demand.

In today's market, high oleic oil is considered to be healthier than high linoleic, since it rich in omega-9 fatty acids that are oxidative more stable than linoleic fatty acid. This trait is important in food industry since a lot of processing activities include higher temperature treatment or converting some unsaturated fats into saturated fats in order to achieve higher melting point. The conversion is important in margarine production because oil stays solid at room temperature. Bearing in mind benefits that high oleic oil has on human health and in industry due to their temperature stability, introduction of *Ol* gene in breeding programs originating from Pervenets became the basis for sunflower breeding for high oleic lines and hybrids, since Pervenets mutant has oleic acid content (OAC) greater than 65% (Soldatov, 1976; Lacombe and Bervillé, 2001, Lacombe et al., 2004).

There are different reports about the inheritance of OAC. Initially, Urie (1984) reported dominant mode of inheritance, while Fick (1984) reported partially dominant mode of inheritance. Later on, there were reports of existence of a modifier gene (Urie, 1985; Miller et al., 1987; Fernández et al., 1999) or one or more genes that influence OAC (Fernández-Martínez et al., 1989; Pérez-Vich et al., 2002; Velasco et al., 2000). In general, OAC varies depending on the genetic background of the recipient genotype.

The molecular change underlying the increase in OAC in Pervenets is the duplication of the *FAD2-1* allele. FAD2 (oleoyl-phosphatidyl choline desaturase) is an enzyme that catalyses synthesis of linoleic acid from oleic acid (Okuley et al., 1994). Three FAD genes are present in sunflower genome: *FAD2-1*, *FAD2-2*, *FAD2-3* (Hongtrakul et al., 1998; Martínez-Rivas et al., 2001). Of those three, only *FAD2-1* is strongly expressed in developing seeds (Hongtrakul et al., 1998). Partial duplication of this gene led to silencing of the *FAD2-1* gene, thus decreasing the activity of FAD enzyme leading to accumulation of oleic acid (Lacombe et al., 2002). *FAD2-1* was reported to cosegregate with *Ol* gene at LG14 (Lacombe and Bervillé, 2001; Pérez-Vich et al., 2002; Schuppert et al., 2006). Hongtrakul et al. (1998) and Schuppert et al. (2006) reported that duplicated sequence of *FAD2-1* does not differ from the corresponding wild type sequence.

So far, different molecular tools were used for analysis of *FAD2-1* gene (Hongtrakul et al., 1998; Dehmer, and Friedt, 1998; Lacombe and Bervillé, 2001; Lacombe et al., 2000; 2002; 2004; 2009, Schuppert et al., 2006). Some of these reports include identification or development of molecular markers for detection of *FAD2-1*. At the Institute of Field and Vegetable Crops there are 2 registered high oleic sunflower hybrids, however we are expanding our breeding program for creation of greater variety of high oleic hybrids.

In present work sunflower inbred lines were selected from a considerable sunflower collection developed at the Institute of Field and Vegetable Crops, Novi Sad (IFVCNS) and was screened for presence of *Ol* mutation by use of INDEL molecular marker reported by (Schuppert et al., 2006). This marker is developed to detect presence of *Ol* mutation since forward primer corresponds to the intergenic region present in *Ol* mutation and reverse primer is complementary to coding region of *FAD2-1*. To verify molecular results, OAC of chosen lines was analyzed by use of gas chromatography (GC). The main goal of present work was to evaluate the efficiency of the INDEL marker for marker assisted selection in IFVCNS lines and to identify the best high oleic parental lines for future crossings.

MATERIAL AND METHODS

Plant material

Chosen plant material for analysis includes lines that are used in current breeding program at the IFVCNS and vary in OAC (Table 1). Additionally, four mutant lines (M-1, M-2, M-3, M-4) derived from high oleic proprietary line developed at the IFVCNS were analyzed in order to try do detect changes on a molecular level that underlined decrease in OAC.

Plants were grown in growth chamber in Klasmann Deilmann Substrat 1 until reaching two leaf-pair stage when leaves were sampled for DNA extraction. Out of each examined sunflower line a bulk sample of 10 plants was formed and plant leaves were kept at -70^{o}C until DNA extraction.

Oleic acid content

Oil samples were obtained by pressing of 2 grams of seeds in a hydraulic press (Sirio, Mikodental 10 tons stregth, cc 400 bars) to yield approximately 0.5 ml of oil available for GC analysis. In the reaction vial 270 µl of TMSH (transesterification agens) was added to exactly 30 µl of oil, well shaked in the vortex, and kept at room temperature for an hour.

Table 1. Tested sunflower genotypes, their oleic acid content and obtained molecular profiles (presence or absence of a part of the *FAD2-1D* sequence)

Genotype - sunflower line	Oleic acid content in %	Presence of *FAD2-1D* mutation*	Genotype - sunflower line	Oleic acid content in %	Presence of *FAD2-1D* mutation *
L1	88.61	+	L34	79.17	+
L2	87.74	+	L35	78.98	+
L3	87.39	+	L36	78.56	+
L5	87.04	+	L37	77.35	+
L6	86.63	+	L38	77.06	+
L7	86.62	+	L39	76.42	+
L8	86.56	+	L40	75.33	+
L9	86.29	+	L41	74.15	+
L10	85.94	+	L42	70.22	+
L11	85.55	+	L43	69.40	+
L12	85.41	+	L44	69.33	+
L13	85.10	+	L45	68.29	+
L14	84.92	+	L46	68.29	+
L15	84.72	+	L47	63.45	+
L16	84.69	+	L48	62.04	+
L17	84.17	+	L49	58.25	+
L18	84.04	+	M-4	56.58	+
L19	83.63	+	M-3	50.13	+
L20	83.49	+	M-1	49.93	+
L22	83.45	+	M-2	36.48	+
L23	82.91	+	L50	34.46	-
L24	82.88	+	L51	28.30	-
L25	82.31	+	L52	24.52	-
L26	81.64	+	L53	22.03	-
L27	81.39	+	L54	21.53	-
L28	81.29	+	L55	21.47	-
L31	80.57	+	L56	17.31	-
L30	80.37	+	L57	17.03	-
L32	79.51	+	L58	14.24	-
L33	79.47	+			

* presence of amplified band (+), absence of amplified band (-)

The oleic acid was identified using a reference mixture of fatty acids methyl esters (FAME). A multi-standard from Supelco (FAME RM-1, Cat. no. O7006) containing the methyl esters of palmitic, stearic, oleic, linoleic, linolenic and arachidic fatty acids was used to confirm the retention times as well as to confirm that the peak areas reflected actual composition of these mixtures.

Oleic acid content analysis was performed on Agilent 5890 gas chromatograph equipped with flame ionization detector (FID) and split/splitless injector (split ratio of 1:50). The separation was performed on a fused silica capillary column (HP-INNOWAX, 30m×0.25mm i.d., and 0.25µm film thickness). Helium was used as carrier gas at a constant pressure of 53kPa at 50°C min). The temperature program was as follows: initial temperature of 50°C was held for 1 min, increased to 200°C at a rate of 25°C/min, then increased to 230°C at a rate of 3°C/min, and and hold for 18 min. The injector and detector temperatures were set at 250 and 280°C respectively. The sample volume injected was 1 µl. The results were processed using ChemStation software and expressed as the percentage of individual fatty acids in the oil sample.

Molecular analysis

DNA was extracted from leaves by use modified CTAB protocol (Permingeat et al., 1998). For detection of *FAD2-1D* sequence primer pair F4-R1 was used (Schuppert et al., 2006). PCR was performed as described by Schuppert et al. (2006) in mix described by Dimitrijević et al. (2010). Products of PCR amplification were run on 2% agarose gels and visualized with the BIO-Print system (Vilber Lourmat, Marne-La-Vallée, France).

RESULTS AND DISCUSSION

Oleic acid content varied between tested lines, ranging from 14.24 to 88.61% (Table 1, Figure 1). Thirty one sunflower line (L1-L31) had OAC higher that 80% , 22 lines (L32-L49 and M-1, M-2, M-3, M-4), had OAC ranging between 36 and 80% and 9 lines (L50-L58) had less than 36% OAC. Even though mutant lines, (M-1, M-2, M-3, M-4) originate from high oleic line, GC analysis showed significant decrease in OAC (Table 1).

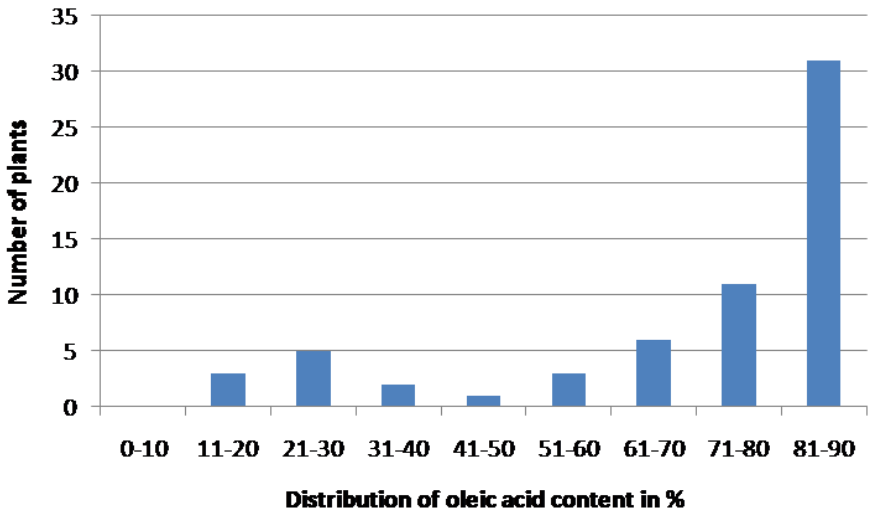

Figure 1. Distribution of oleic acid content (%) in examined sunflower genotypes

In order to examine the presence of *Ol* mutation in tested lines F4-R1 primer was used (Schuppert et al., 2006). Out of 62 chosen genotypes, seeds of three lines did not germinate; consequently they were excluded from the molecular analysis. Molecular marker used amplified a band of expected length (approximately 650 bp) in all sunflower lines, except in lines L50-L58 that had low OAC ranging from 14.24 to 34.46% (Figure 2). Presence of an amplified band in all tested mutant lines showed that there is an *Ol* mutation present in examined lines, consequently

some other changes on a molecular level must have happened and caused significant decrease in OAC. Since EMS was used for treatment of wild-type line, small nuclear changes could have occurred in *FAD2-1D* sequence, as EMS most frequently induces SNPs (G to A and C to T point mutations) (McCallum et al., 2000), as was the case with high oleic mutant lines developed by León et al. (2013). Consequently, there is a possibility that some small changes occurred in amplified sequence which could not be detected by electrophoresis. Alternatively, some changes might have occurred in other parts of *FAD2-1D* sequence or somewhere else in sunflower genome. However, this is unlikely since most of the reports on molecular changes in fatty acid composition occurred in the sequence of encoding enzymes (León et al., 2013).

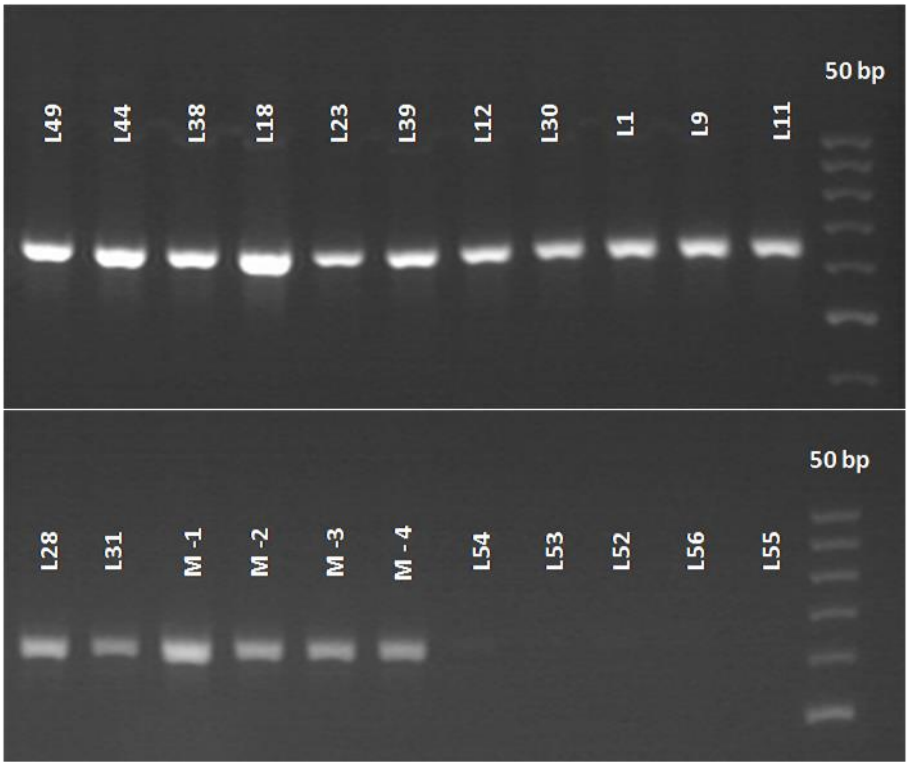

Figure 2. Molecular profiles of high oleic, low oleic and mutant sunflower lines obtained by amplification with F4-R1 (Schuppert et al., 2006) (DNA ladder 50 bp, Thermo Scientific)

In this study, we examined OAC in a set of sunflower lines and established that there is a great variation in OAC in comparison to studies performed by Lacombe et al. (2004), since in this research high oleic lines with OAC ranging from 83 to 91%. and low oleic lines with OAC ranging from 23 to 39% were used for molecular studies. The great variation in OAC could be explained by the fact that OAC is influenced not only by genetic background (Lancombe et al., 2001; Schuppert et al., 2006), but also by the environmental conditions, primarily temperature, but also by sowing date etc. (Triboï-Blondel et al., 2000; Flagella et al., 2002; Izquierdo et al., 2002; Del Gatto et al., 2015).

Molecular marker used in this study successfully identified high oleic genotypes and could therefore be used in marker assisted selection in IFVCNS. However, *Ol* mutation was detected in mutant lines that had lower OAC, as well. This means that molecular breeders should always be aware of the genetic background used in breeding and verify results with GC.

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