INTERNATIONAL SYMPOSIUM ON SUNFLOWER GENETIC RESOURCES

October 16 – 20, 2011

KUŞADASI, IZMIR, TURKEY

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FANTASIA DELUXE HOTEL, KUŞADASI, IZMIR, TURKEY

Organized By

Trakya Agricultural Research Institute Edirne, Turkey

http://www.ttae.gov.tr

International Sunflower Association (ISA) - Paris, France

http://www.isa.cetiom.fr

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WELCOME NOTES

As organizing committee of **International Symposium on Sunflower Genetic Resources,** we would like to thank you firstly for coming to Turkey, and for presenting your scientific works and sharing your knowledge with us. I would like to thank also International Sunflower Association for contribution to our event.

Our symposium brings together about 90 sunflower researchers from government and commercial institutions in worldwide to on sunflower to promote cooperation and share knowledge among researchers largely. Total 31 papers (25 oral & 16 posters) will be presented in the symposium.

The aim of our symposium is to present the newest research results and research goals to analyze and then solve current problems in sunflower with enhancing and improving our knowledge. Sunflower genetic resources is so important for our future because they are keeping for us so valuable genes for sunflower breeders to enhance genetic base for improving high yielding and quality in sunflower. As always, we also extend a warm welcome to all our colleagues in the sunflower research and industry who interest to improve and increase their income of sunflower producers.

I am sure that all guests will satisfy both scientifically getting all knowledge and sharing imformation with these very valuable scientists and ad also getting pleasure in Turkey with spending your very valuable time in staying in this nice hotel, eating delicious Turkish dishes, sightseeing for history and beautiful landscape. Aegean region of Turkey contains very nice archaeological sites, beautiful beaches, great scenery, and a host of towns that are excellent destinations. Kusadasi, which means "bird island", is set in a superb gulf in the Turkey and is known for its turquoise sparkling water of the Sea, broad sandy beaches, bright sun. Kusadasi is also your gateway to Ephesus, a city created by Ionians and later expanded by the Romans. It considered today one of the grandest sites in the ancient world, the region also hosted the likes of Cleopatra, the Virgin Mary and John the Apostle and close to many historical sites such as Didyma, Priene, Miletos, etc.

We are also sure that these days and full day sightseeing tour will be enough to notice the beauty of area but not enough to discover it. We wish you wonderful stay and great fun in Turkey during our symposium.

Assoc Prof Dr. Yalçın KAYA
Chair
On the behalf of Organizing Committee

FOREWORD

Trakya Agricultural Research Institute (TARI) was constituted as orchard station in 1924, and then connected under in Ministry of Agriculture. TARI turned out to be research station in 1949 and became Regional Agricultural Research Institute at 25 December 1969. After 1 May 1987, it was named as Trakya Agricultural Research Institute. TARI carried out research on field crops and plant protection in Trakya region which is in European part of Turkey. Additionally, TARI got responsibility as regional coordinator on pasture and grassland management and improvement research and works in Marmara Region. TARI has been working on sunflower, rice, wheat, barley, oat, soybean, safflower, flax, canola etc. to develop new cultivars which have high quality, yielding and adaptation capability, new agronomy techniques to increase farmer income, to determine alternative crop for the region and to produce elite and certified seed for seed producers and farmers.

Although sunflower history was starting at 1960s in Turkey, the main sunflower research and breeding program in sunflower was initiated in our institute in 1970s. However, sunflower breeding program were accelerated in 1978 after starting as National Sunflower Research Program in Turkey. Then, our institute nominated also as the national coordinator institute for sunflower research in Turkey. At the beginning of 1980s, sunflower genetic materials were collected mostly via introduction and from different parts of Turkey and the world in TARI, then sunflower breeding research were speeded up as national basis including hybrid breeding year by year.

We would like to thank you to join this symposium and I would like to give special thanks our sponsors; they give us big supports to organize this symposium.

Dr. Necmi BEŞER
Director
Trakya Agricultural Research Institute

FOREWORD

On behalf of the Organizing Committee, we would like to welcome all participants to our symposium and we would like thank you to join our event.

As a general director of The General Directorate of Agricultural Research and Policy (GDARP) and representing our Ministry, I would like to give some information about our goals and priorities. As being headquarters of national agricultural research system, development of research strategy of Turkey, determination of priorities and coordination of research programs are the main objectives of us. Currently, we are working as research institutes and stations under our supervision dealing with the whole range of agricultural issues throughout our country.

Sunflower is the main oil crop for Turkey both also in Blacksea Region countries having more than half of world sunflower areas and production. We are importing high amount of oil seeds so we want to increase our oil crops production in Turkey. Because of that, as Ministry and government policy, we apply some subsidies to increase sunflower and other oil crops. Sunflower also exists at first rank on research priorities of GDARP, both in national and international level.

As the representative of Turkey in EU, I also would like to mention that starting the importance new project ideas on EU Research Framework. As existing in the symposium program, if you or your organizations are interested to join taking part in preparing new projects, this will be great opportunity for further developments of sunflower and genetic rresources research. These efforts will contribute to increase our collaboration at international level among us. As GDARP, not only in sunflower, both also in all crops, we are ready to collaborate so willingly with you.

We hope that this symposium will address problems of the related countries, and we hope that a good network for collaboration can be established and a better relationship developed between all the countries represented. Finally, we wish success for this meeting and hope a great scientific achievement with your contributions. We would like to add that we are too much pleased to host you all in Kusadasi, and in our country.

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

Assoc. Prof. Dr. Masum BURAK,
General Director,
The General Directorate of Agricultural Research and Policy -Turkey

PROCEEDINGS OF INTERNATIONAL SYMPOSIUM ON SUNFLOWER GENETIC RESOURCES

ORGANIZING COMMITTEE (International Sunflower Association BOARD):

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Veli PEKCAN	Symposium Secretary
Dr A. Semsettin TAN	Member
Ibrahim M. YILMAZ	Member
Tugba SAGIRLI	Member

SCIENTIFIC COMMITTEE:

Doc Dr Yalcin KAYA	Member
Dr Goksel EVCI	Member
Dr A. Semsettin TAN	Member
Prof Dr Nazan DAGUSTU	Member
Prof Dr Önder ÇAYLAK	Member
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Prof Dr Dragan SKORIC	Member
Dr Maria PACUREANU	Member
Dr Laura F. MAREK	Member
Dr Sreten TERZIC	Member
Dr Victor KIRICHENKO	Member
Prof Dr Vera GAVRILOVA	Member
Prof Dr Michail CHRISTOV	Member

The hotel and sightseeing tour arrangements are organized by SSC Tour Travel Agency.

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SYMPOSIUM PROGRAM

SUNDAY, OCTOBER 16, 2011	
17^{00}-18^{30}	**REGISTRATION**
MONDAY, OCTOBER 17, 2011	
8^{30} 9^{30}	**Registration**
9^{30} 10^{00}	**Opening Talks:** Assoc. Prof. Dr. Yalcin KAYA, Chair, Organizing Committee Dr. Necmi BESER, Director of Trakya Agricultural Research Institute Dr Carlos FEOLI, The President of International Sunflower Association Assoc. Prof Dr. Masum BURAK, Director General, GDAR-Turkey
	Session Chair : Dr. Carlos FEOLI
10^{00} 10^{30}	**Invited speaker: Dr. Felicity VEAR** **DIVERSITY AMONG CULTIVATED SUNFLOWER RESOURCES AND USE IN BREEDING** **Felicity Vear**, Elena Cadic, Patrick Vincourt
10^{30} 11^{00}	**Invited speaker: : Prof. Dr. Gerald SEILER** **GERMPLASM RESOURCES FOR INCREASING THE GENETIC DIVERSITY OF GLOBAL SUNFLOWER** **Gerald Seiler**, Laura Fredrick Marek
11^{00} 11^{30}	Coffee break
1ST SESSION: MOLECULAR BREEDING METHODS:	**Session Chair : Dr. Leonardo VELASCO**
11^{30} 11^{50}	**DNA POLYMORPHISM OF WILD SUNFLOWER ACCESSIONS HIGHLY SUSCEPTIBLE OR HIGHLY TOLERANT TO WHITE ROT ON STALK** **D. Miladinovic,** K. Taski-Ajdukovic, N. Nagl, B. Kovacevic, S. Jocic, V. Miklic
11^{50} 12^{10}	**ESTABLISHMENT OF APICAL SHOOT MERISTEM CULTURE FOR IN VITRO CONSERVATION OF SUNFLOWER (*H. annuus* L.) GENETIC RESOURCES** **Nazan Dağüstü ,** Melek Bayraktaroğlu, Birgül Güden
12^{10} 12^{30}	**MOLECULAR ANALYSIS OF SUNFLOWER (*Helianthus annuus* L.) GENOTYPES FOR HIGH OLEIC ACID USING MICROSATELLITE MARKERS** **Nagarathna, T.K.**, Shadakshari, Y.G., Ramanappa, T.M. Shashidhara, N, Varsha R. H., Ningaraju, T. M.
12^{30} 13^{30}	Lunch
13^{30} 13^{50}	**IN VITRO REGENERATION OF SUNFLOWER (*H. ANNUUS* L.) FOR GERMPLASM PROTECTION** **Melek Bayraktaroğlu**, Nazan Dağüstü
13^{30} 13^{50}	**DISCUSSION PART**
2ND SESSION: CLASSICAL BREEDING METHODS UTILIZING WILD SPECIES	**Session Chair : Dr Andre POUZET**
13^{30} 13^{50}	**DIVERSIFYING GERMPLASM AS A BASIS OF GENETIC PROGRESS IN SUNFLOWER, FOR DROUGHT TOLERANCE, IN THE CONTEXT OF CLIMATE CHANGE** Florentina Sauca, **Maria Joita – Pacureanu**
13^{50} 14^{10}	**CREATING NEW GENETIC VARIABILITY IN SUNFLOWER USING INDUCED MUTATIONS** S. Cvejic, S. Jocic, S. Prodanovic, **S. Terzic**, D. Miladinovic, I. Balalic
14^{10} 14^{30}	**UTILIZING FROM WILD TYPES IN SUNFLOWER BREEDING FOR NEW PLANT DESIGN AND ANATOMY FOR HIGH YIELD PERFORMANCE** **Y. Kaya**, G. Evci, V. Pekcan, M. I. Yilmaz
14^{10} 14^{30}	**RESULTS OF THE SCIENTIFIC PROGRAM FOR SUNFLOWER BREEDING** **V.V. Kyrychenko**, V. P. Kolomatska,
14^{10} 14^{30}	**CLASSIFICATION OF JERUSALEM ARTICHOKE ACCESSIONS BY DISCRIMINANT ANALYSIS OF MINERAL CONCENTRATION IN TUBERS AND LEAVES** **S. Terzic**, M. Zoric, J. Atlagic, I. Maksimovic, T. Zeremski, B. Dedic
14^{30} 15^{00}	**DISCUSSION PART**
15^{00} 15^{30}	Coffee Break
3RD SESSION: INTERSPECIFIC HYBRIDIZATION:	**Session Chair : Dr Vladimir MILKIC**
15^{30} 15^{50}	**STUDY OF HYBRID MATERIAL ORIGINATED FROM INTERSPECIFIC CROSSES WITH WILD *HELIANTHUS ANNUUS* FOR RESISTANCE TO DISEASES AND PARASITE BROOMRAPE** D. Valkova, **M. Christov,** V. Encheva, P. Shindrova, J. Encheva, M. H. - Cherbadzi
15^{50} 16^{10}	**NEW SUNFLOWER FORMS, LINES AND HYBRIDS, OBTAINED BY HYBRIDIZATION BETWEEN**

	CULTIVATED SUNFLOWER AND ACCESSIONS FROM DIFFERENT *HELIANTHUS* SPECIES M. Christov, **M. Hristova-Cherbadzi,** V. Encheva, P. Shindrova, D. Valkova
16^{30} 17^{00}	**DISCUSSION PART**
16^{30} 17^{30}	**Poster Session**
16^{30} 18^{30}	**ISA BOARD MEETING**
18^{30} 20^{00}	Dinner
TUESDAY, OCTOBER 18, 2011	
4TH SESSION: GENETIC RESOURCES FOR IMPORTANT YIELD TRAITS Session Chair : Prof Dr Gian Paolo VANOZZI	
09^{30} 09^{50}	**SUNFLOWER GENETIC AND CHARACTER COLLECTIONS AT VIR** **V. A. Gavrilova**, I.N. Anisimova, V.T. Rozhkovaa, E.A.Pepelyaeva
09^{50} 10^{10}	**ROOT CHARACTERS, ISOTOPE DISCRIMINATION, PHYSIOLOGICAL AND MORPHOLOGICAL TRAITS AND THEIR RELATIONSHIP TO IDENTIFY THE DROUGHT TOLERANT SUNFLOWER (*Helianthus annuus* L.) GENOTYPES** **Nagarathna, T.K**., Shadakshari, Y.G., Ramakrishna Parama, V.R., Jagadish, K.S., Puttarangaswamy, K.T., Shashidhara, N., Varsha R. H.
10^{10} 10^{30}	**SUNFLOWER (*Helianthus anuus* L.) GENETIC RESOURCES OF TURKEY** **Ahmet Semsettin TAN,** Ayfer TAN
10^{30} 11^{00}	Coffee break
11^{00} 11^{20}	**THE BEHAVIOUR OF SOME ROMANIAN AND FOREIGN SUNFLOWER CULTIVARS TO THE MAJOR PEST AGENTS IN THE DOBROGEA AREA** **JINGA V.** ILIESCU H., LAZUREANU C, MANOLE D, GIUMBA ANAMARIA
11^{20} 11^{40}	**CHARACTERIZATION AND EVALUATION OF SUNFLOWER GERMPLASM (*Helianthus annuus* L.)** M.Y. Dudhe, H.P. Meena, M. Sujatha and **A.R.G. Ranganatha**
11^{40} 12^{00}	**EVALUATION OF DROUGHT RESPONSE OF SUNFLOWER SYNTHETIC VARIETIES / LINES** Khamsee Saensee, Thitiporn Machikowa, **Nooduan Muangsan**
12^{00} 12^{30}	**DISCUSSION PART**
12^{30} 13^{30}	**LUNCH**
5TH SESSION: GENETIC RESOURCES FOR SEED AND OIL QUALITY, WEED, DISEASE AND INSECT RESISTANCE Session Chair : Dr Maria PACUREANU	
13^{30} 13^{50}	**PERFORMANCE AND SEED QUALITY OF LOCAL MOROCCAN SUNFLOWER VARIETIES AND SPANISH LANDRACES USED FOR CONFECTIONARY AND SNACK FOOD** A. Nabloussi, Á. Fernández-Cuesta, J. M. Fernández-Martínez, **L. Velasco**
13^{50} 14^{10}	**ANALYSIS OF FATTY ACID PROFILE AND TOCOPHEROL CONTENT OF COLD PRESSED SUNFLOWER OILS DERIVED FROM DIFFERENT HIGH OLEIC GENOTYPES** **Zoltán Áy**, Mónika Varga, Melinda Tar, Rozália Nagyné Kutni, József Frank
14^{10} 14^{30}	**GENETIC COLLECTION ON FATTY ACID COMPOSITION OF SUNFLOWER SEED OIL** **Yakov Demurin**, Oxana Borisenko
14^{30} 14^{50}	**PHYTOSTEROLS IN THE SEEDS OF WILD SUNFLOWER SPECIES** Á. Fernández-Cuesta, L. Velasco, **J. M. Fernández-Martínez**
14^{50} 15^{10}	**DISCUSSION PART**
15^{20} 15^{30}	Coffee break
15^{30} 15^{50}	**EVALUATION OF SOME ANNUAL WILD SUNFLOWER SPECIES FOR RESISTANCE TO BROOMRAPE** B Dedić, **S. Terzić**, S. Tančić, J. Atlagić, J. Mrđa, V. Miklič
15^{50} 16^{10}	**SOURCES OF RESISTANCE TO THE LEAVE PATHOGENES CAUSE GREY (*PHOMOPSIS HELIANTHI*) BROWN (*ALTERNARIA SP*.) AND BLACK (*PHOMA MACDONALDI*) SPOTS ON SUNFLOWER** *Valentina Encheva, Daniela Valkova,* ***Michail Christov***
Discussion Session: Project Opportunities in Sunflower Genetic Sources Session Chair: Prof Dr Dragan SKORIC	
17^{00}	Closing the symposium
18^{30} 21^{30}	GALA DINNER
WEDNESDAY, OCTOBER 18, 2011 SIGHTSEEING TOUR (KUSADASI AND AROUND)	
07^{00} 14^{00}	Visit Ephesus Antique City, Virgin Marry House, St. Jean, Artemis Temple, etc..
14^{00} 15^{00}	Lunch at hotel
14^{00} 19^{00}	Visit Kusadası and Shopping, City Tour.
19^{00} 20^{00}	Dinner
THURSDAY, OCTOBER 20, 2011, Leaving from the hotel	

PARTICIPANT LIST

#	Name	Institution	Country
1	Dr Carlos FEOLI	President of ISA	Argentina
2	Mauro M. Sposaro	Nidera Semillas Co.	Argentina
	Christa Heinzl	Wintersteiger Co.	Austria
3	Luc Maertens	Devgen Seed Co.	Belgium
4	Andreas Schumacher	BASF Co	Czech Rebuplic
5	Gamze Arlt	BASF Co	Czech Rebuplic
6	Matthew Blaken	BASF Co	Czech Rebuplic
7	Dr Miroslava Hristova	University of Forestry, Sofia	Bulgaria
8	Prof Michail Christov	Dobroudja Research Institute	Bulgaria
9	Muriel ARCHIPIANO	Soltis Seed Co.	France
10	Andre POUZET	CETIOM	France
11	Dr Felicity VEAR	INRA, UMR	France
12	Pierre Castellanet	CAUSSADE SEMENCES	France
13	Philippe JOUVE	Advanta Europe	France
14	Venkatesh Hubli	Devgen Seed Co.	India
15	Nagarathna, T.K	Univ. of Agricultural Sciences, Bangalore	India
16	Mangesh Y. Dudhe	Directorate of Oilseeds Research	India
17	Zoltan AY	Szeged GKI	Hungary
18	Dr David MOGFORD	Dow Agro Sciences	Hungary
19	Páricsi Sándor	Dow Agro Sciences	Hungary
20	Amir Gharib Eshghi	Seed and Plant Improvement Ins, Zanjan	Iran
21	Prof Dr Gian Paolo VANOZZI	University of Udine	Italy
22	Kulpash Bulatova	Kazakh Scientific Research Institute of Farming and Plant Growing	Kazakhistan
23	Dr Abdelghani Nabloussi	INRA - CRRA de Meknès	Morocco
24	Prof Dr Alberto Escalante	Colegio de Postgraduados, Mexico City	Mexico
25	Muhammad Ayub Khan	National Agricultural Research Center	Pakistan
26	Dr Vasile JINGA	Research Institute for Plant Protection	Romania
27	Dr Maria Pacureanu	Fundulea Research Institute	Romania
28	Georgeta DİCU	PROCERA Genetics Ltd.	Romania
29	Andreea-Elena TEODORESCU	PROCERA AGROCHEMICALS Ltd.	Romania
30	Mihaela IONITA	PROCERA AGROCHEMICALS Ltd.	Romania
31	Nicoleta-Claudia SANDU	PROCERA AGROCHEMICALS Ltd.	Romania
32	Daniela HORHOCEA	PROCERA AGROCHEMICALS Ltd.	Romania
33	Nicolae BOAGHE	PROCERA AGROCHEMICALS Ltd.	Romania
34	Viorel-Ioan BORCAN	PROCERA AGROCHEMICALS Ltd.	Romania
35	George Aldescu	SAATEN UNION ROMANIA SRL	Romania
36	Bogdan Guta	SAATEN UNION ROMANIA SRL	Romania
37	Dr. Tatiana Antonova	VNIIMK Research Institute	Russia
38	Dr Oxana Borisenko	VNIIMK Research Institute	Russia
39	Dr Yakov DEMURİN	VNIIMK Research Institute	Russia
40	Nikolaj Ivanovich Benko	Agro-Plazma Ltd	Russia
41	Prof Dr Vera GAVRILOVA	Vavilov All-Russian Research Institute	Russia
42	Peter K. SEVASTYANOVICH	AGROSEMINVEST Co	Russia
43	Evgeny P. NIKOLAEVICH	AGROSEMINVEST Co	Russia
44	Prof Dr Dragan SKORIC	Serbian Academy of Sciences	Serbia

45	Dr Vladimir MILKIC	Novisad Research Institute	Serbia
46	Dr Sinisa JOCIC	Novisad Research Institute	Serbia
47	Dr Dragana MLADIVONIC	Novisad Research Institute	Serbia
48	Dr Sreten TERZIC	Novisad Research Institute	Serbia
49	Dr Leonardo VELASCO	Inst. de Agricultura Sostenible Cordoba	Spain
50	Prof Dr Jose Maria Fernandez	Inst. de Agricultura Sostenible Cordoba	Spain
51	Jorge M. MORALES	Fito Semillas Co.	Spain
52	Rachil Koumproglou	Fito Semillas Co.	Spain
53	Thitiporn Machikowa	Suranaree University of Technology	Thailand
54	Nooduan Muangsan	Suranaree University of Technology	Thailand
55	Dr. Necmi BEŞER	Trakya Agricultural Research Institute	Turkey
56	Doc Dr Yalcin KAYA	Trakya Agricultural Research Institute	Turkey
57	Dr Goksel EVCI	Trakya Agricultural Research Institute	Turkey
58	Veli PEKCAN	Trakya Agricultural Research Institute	Turkey
59	Ibrahim M. YILMAZ	Trakya Agricultural Research Institute	Turkey
60	Mohan BENTUR	MAY Seed Co	Turkey
61	Geoffrey Lloyd Thomas	MAY Seed Co	Turkey
62	Okan Poyraz	MAY Seed Co	Turkey
63	Duran ZARARSIZ	Agromar AŞ	Turkey
64	Mahir KARA	Agromar AŞ	Turkey
65	Semra YANIKOĞLU	Agromar AŞ	Turkey
66	Sebahattin Bodur	Agromar AŞ	Turkey
67	Dr Salim ERBAŞ	Agromar AŞ	Turkey
68	Sebnem PULLUKCU	BASF Turkey	Turkey
69	Süleyman ALTINTAŞ	BASF Turkey	Turkey
70	Adnan ESMER	Marmara Un	Turkey
71	Umit DEMİRCİOĞLU	Limagrain Seed Co Turkey	Turkey
72	Ayhan PİRİNÇÇİ	Limagrain Seed Co Turkey	Turkey
73	Yucel KILIC	Limagrain Seed Co Turkey	Turkey
74	Cemal YÜCEL	Pioneer Seed Co Turkey	Turkey
75	Abdullah ÇİL	East Mediterranean Agricultural Research Inst.	Turkey
76	Ayşe Nuran ÇİL	East Mediterranean Agricultural Research Inst.	Turkey
77	Şahin GİZLENCİ	Blacksea Agricultural Research Institute	Turkey
78	Mustafa ACAR	Blacksea Agricultural Research Institute	Turkey
79	Emel KARACA ÖNER	Blacksea Agricultural Research Institute	Turkey
80	Dr A Şemsettin TAN	Agean Agricultural Research Institute	Turkey
81	Prof Dr Dilek BAŞALMA	Ankara University Agricultural Faculty	Turkey
82	Maryam PASHAZADEH	Ankara University Agricultural Faculty	Turkey
83	Dr Fahriye ERTUĞRUL	TÜBİTAK MAM GMBE Gebze	Turkey
84	Prof Dr Önder ÇAYLAK	Agean University Agricultural Faculty	Turkey
85	Doc. Dr Nazan DAĞÜSTÜ	Uludag University Agricultural Faculty	Turkey
86	Melek BAYRAKTAROĞLU	Uludag University Agricultural Faculty	Turkey
87	Abdullah DİŞBUDAK	Syngenta Seed Co Turkey	Turkey
88	Barbaros Hayrettin GÜLER	Syngenta Seed Co Turkey	Turkey
89	Volodymyr KOVALEX	Sady Ukrajine	Ukraine
90	Victor Kyrychenko	Plant Production Institute - Yuriev	Ukraine
91	Viktor Ryabchun	South Plant Biotechnology Center, Odessa	Ukraine
92	Prof. Dr. Gerald SEILER	USDA ARS, Fargo Research Center,	USA

THE LIST OF PUBLICATIONS

PLENARY SESSION

INVITED PAPERS

MOLECULAR BREEDING METHODS

CLASSICAL BREEDING METHODS UTILIZING WILD SPECIES

INTERSPECIFIC HYBRIDIZATION

GENETIC RESOURCES FOR IMPORTANT YIELD TRAITS

GENETIC RESOURCES FOR SEED AND OIL QUALITY, WEED, DISEASE AND INSECT RESISTANCE

POSTER SESSION

MOLECULAR BREEDING METHODS

CLASSICAL BREEDING METHODS UTILIZING WILD SPECIES

INTERSPECIFIC HYBRIDIZATION

GENETIC RESOURCES FOR IMPORTANT YIELD TRAITS

GENETIC RESOURCES FOR SEED AND OIL QUALITY, WEED, DISEASE AND INSECT RESISTANCE

PART I: INVITED PAPERS

DIVERSITY AMONG CULTIVATED SUNFLOWER RESOURCES AND USE IN BREEDING

Felicity Vear [1], Elena Cadic [2], Patrick Vincourt[2]

[1] INRA, UMR 1095, Domaine de Crouelle, 234, Ave du Brezet, 63000 Clermont-Ferrand, France.

[2] INRA, LIPM, UMR 2594, Auzeville, BP 52627, 31326 Castanat-Tolosan Cedex , France.

The first significant breeding for high oil sunflowers, in Russia from 1930, concerned open pollinated varieties. These were the basis of modern breeding programmes, which started in 1950-60, mainly in Europe, Canada, USA and Argentina, but work in that period in countries such as Morocco, Australia and Chile also produced genotypes of direct agronomic interest, or which widened the genetic variability available. Studies of the structure of this variability have become possible following genotyping of large numbers of inbred lines with microsatellites (2 or 3 per linkage group) and definition of core collections which cover a large part of the diversity in cultivated sunflower. Although some geographic effects on combining ability have been reported, the main groups which appear are characterised by CMS maintenance or male fertility restoration. The collections defined should be useful in association studies to determine genome sequences controlling important phenotypic characters, although, for characters determined by parts of the genome poorly represented by the markers, enriched or specific collections may be necessary. Such knowledge should help to optimize use of sunflower genetic resources in breeding.

GERMPLASM RESOURCES FOR INCREASİNG THE GENETİC DİVERSİTY OF GLOBAL SUNFLOWER

Gerald Seiler[1] Laura Fredrick Marek[2]

[1]USDA-ARS Northern Crop Science Laboratory, Fargo, North Dakota 58102
[2]Iowa State University and USDA-ARS North Central Regional Plant Introduction Station, Ames, Iowa 50011

Gene banks serve as a rich source of genetic diversity that can be exploited for crop improvement. The USDA-ARS formally established a cultivated sunflower germplasm collection at the National Plant Germplasm System, North Central Regional Plant Introduction Station at Ames, Iowa in the 1948, while the wild *Helianthus* germplasm collection was established at the USDA-ARS Bushland, Texas, in 1976. Presently, both collections are located at Ames, Iowa. The genus *Helianthus* consists of 51 species and 19 subspecies, with 14 annual and 37 perennial species. Over 30 explorations in the past 35 years have resulted in the assemblage of a wild sunflower collection that is the most complete in the world. Currently, both collections together contain 4050 accessions, with 1867 cultivated and 2183 wild accessions of which 1353 accessions are annual and 830 are perennial species. This germplasm will be important in the future as a genetic resource to combat emerging pests and environmental challenges, helping to maintain sunflower as a viable major global oilseed crop and preserve it for future generations.

PART II: MOLECULAR BREEDING METHODS

DNA POLYMORPHISM OF WILD SUNFLOWER ACCESSIONS HIGHLY SUSCEPTIBLE OR HIGHLY TOLERANT TO WHITE ROT ON STALK

Dragana Miladinovic[1*], Ksenija Taski-Ajdukovic[1], Nevena Nagl[1], Branislav Kovacevic[2], Sinisa Jocic[1], Vladimir Miklic[1]

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In our work, we have studied DNA polymorphism in two accessions of *Helianthus mollis* which were found to be highly tolerant to mid-stalk white rot and *Helianthus tuberosus* and *Helianthus rigidus* which were found to be highly susceptible to the same disease, using selected RAPD primers. According to the obtained results, the best candidates for potential markers for resistance to *Sclerotinia* mid-stalk rot are fragments 1200 bp and 670 bp, obtained in reaction with primer C04, and fragment 300 bp, obtained in amplification with primer C15. These fragments were present in both resistant accessions of *H. mollis*, but were not observed in the accessions of *H. rigidus* 1844 and *H. tubersus* 6. The fragments that could also be interesting as potential markers are 2000bp and 1100 bp, obtained in reactions with C15 primer, as well as fragment of 650 bp, obtained in reactions with C04. Although these fragments were present in both, resistant and susceptible accessions, the difference in the intensity of obtained bands was significant.

Key words: wild sunflower, *Sclerotinia*, DNA polymorphism

Acknowledgements: This work is a part of project TR31025 supported by Ministry of Education and Science of Republic of Serbia.

ESTABLISHMENT OF APICAL SHOOT MERISTEM CULTURE FOR IN VITRO CONSERVATION OF SUNFLOWER (*Helianthus annuus* L.) GENETIC RESOURCES

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The high regeneration capacity is important for *in vitro* conservation of genetic resources and transformation studies. The research was conducted at Uludag University, Agricultural Faculty, Field Crops Department, and Plant Tissue Culture Laboratory in 2011. Ten genotypes (T0910817-1, T0910950-2, T0910791-3, T0910182-2, T0910792-1, T0912285-1, T0911033-2, T0910791-1, T0910791-4, T0910930-2.) were used as plant materials. The apical *s*hoot meristems of sunflower genotypes *(Helianthus annuus L.)* were dissected from 4 day-old seedlings, were transferred to ½ MS medium allowing shoot and root development. The experiments were placed into the growth chamber in 16/8 hour light/dark photoperiod at 26± 2 ^{0}C for two weeks. They were transplanted into viol containing a 1:1:2 peat: perlite: soil mixture (v/v) for acclimatisation, were covered with naylon bags and were kept at 24 ± 2^{o}C in 16h/8 h (light/dark) in a growth chamber for 2 weeks. Young plantlets were transferred to unsterile soil, develop to maturity and were then self pollinated in the natural conditions. The agronomic characters (plant height, number of leaf, number of branches, the diameter of head, and the diameter of stalk) of *in vitro* grown plants were measured before harvesting. Data was analysed with Jump statistical programme in the completely randomised design with 3 replications, each replication consisted of one pot with 6 plants.

Out of 10 genotypes, seven showed a notable response to the *in vitro* establishment. The 57% of all cultured apical shoot meristems developed into vigorous plantlets with 3-6 leaves. The majority of the developed plantlets had vigorous root. The only 69% of plantlets was grown to maturity. The analysis of variance for all characters except number of branches resulted in significant differences among genotypes at 5% level. The genotype with a relatively high regeneration capacity and agronomic performances was T0911033-2 followed by T0910950-2. Plant regeneration from apical shoot meristem of sunflower is practical and efficient when appropriate genotype is used.

Key words: sunflower, apical shoot meristem , fertile plant regeneration

MOLECULAR ANALYSIS OF SUNFLOWER (*Helianthus annuus* L.) GENOTYPES FOR HIGH OLEIC ACID USING MICROSATELLITE MARKERS

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Sunflower, an important oil seed crop in the world, contains 30-45% oil in their seeds. The oil contains poly unsaturated fatty acids (14-25% oleic acid and 41-74% linoleic acid) and saturated fatty acids (5-8% palmitic acid and 2-3% stearic acid). Oils with more unsaturated fatty acids are preferred as they lower the cholesterol content in the body. High oleic sunflower oil (>80% oleic acid) has a higher oxidative stability than most other cooking oils and they are most effective in preventing cardio vascular diseases. Hence, an experiment was conducted with a major objective to evaluate diverse germplasm lines for high oil content and high oleic acid and to identify molecular markers for high oleic acid. The genotypes included CMS-lines (142 entries), R-lines (145), germplasm lines (300) and inbreds (168). Initially the selected genotypes were screened with 45 SSR markers. Among them two primers showed differentiating bands with low and high oleic contents. To confirm these two primers, initial study was carried out with the released hybrids from University of Agricultural Sciences, Bangalore and Raichur, India. Simultaneously fatty acid profiling was done for four fatty acids using gas chromatography-mass spectroscopy. The results were then compared. When the PCR products with two primers were checked on 1.5% agarose gel, multi banding pattern was observed for genotypes with >80% oleic acid. Oleic acid content was high in a hybrid RSFH-1 (88.20%) and its female parent CMS-103A (90.58%). In all other genotypes, a single band was detected as they were low to mid oleic types. Oil content was also estimated in these genotypes by NMR spectrometer. The range for oil content was from 32% to 44% whereas; it was from 23.63% to 90.58% for oleic acid. The two primers will be used for further screening of all the genotypes and the selected parental lines will be used in heterosis breeding and contrasting genotypes will be selected for developing mapping populations.

Key words: fatty acid composition, oleic acid, SSR markers, sunflower.

IN VITRO REGENERATION OF SUNFLOWER (*HELIANTHUS ANNUUS* L.) FOR GERMPLASM PROTECTION

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The aim of this study was to determine *in vitro* regeneration capacity of selected genotypes and develop a regeneration protocol for commercial sunflower (*Helianthus annuus* L.) genotypes for using germplasm protection studies. The experiment was set up at Uludag University, Faculty of Agriculture, Department of Field Crops, Tissue Culture Laboratory in 2010. The cotyledon and hypocotyl explants were excised from 3 day-old seedlings of sunflower genotypes; Sirena (MayAgro Seed Corporation) and Pactol (Agromar A.Ş.). To determine the effect of hormone consentrations explants were cultured in sixteen different embryo induction medium (EIM) supplemented with four different rates of (0.1, 0.5, 1.0, 1.5 %) benzylaminopurine (BA) and Naphthaleneacetic acid (NAA), %0.1 Gibberellic acid (GA_3) and 0.05% casein hydrolysate. The experiments were kept in 18/6 hour light/dark photoperiod at 26±2 ^{o}C for one month. The sunflower genotypes have been tested for their ability to produce callus, shoot and root organs, embryo like structure (ELS) and plantlet formation. The data were taken after two weeks. The experiment was analyzed by using JUMP statistical packet programmed according to completely randomized design with 3 replications.

The rates of callus shoot and root organ formation depending on the genotype, explant, medium and the interactions between each of them. The rate of plantlet depended on the medium, genotype and interaction between genotype and medium while the rate of ELS depended on interactions between genotype and medium, genotype and explant. The highest root and shoot regeneration were obtained from cotyledone explants while hypocotyle explants produced the highest callus formation. The third medium (0.1% BA, 1% NAA) gave the best shoot (10.00%) and root (6.50%) regeneration, while the best callus formation as a score (2.45) was seen from twelfth (1% BA; 1,5% NAA) and sixteenth medium (1.5% BA; 1.5% NAA). The first medium (0.1% BA; 0.1% NAA) gave the highest plantlet formation (6.50%) while the highest ELS (2.50%) was obtained from second medium (0.1% BA; 0.5% NAA). The genotype, Pactol had the best results in terms of shoot and root regeneration (2.00%, 1.31% respectively), plantlet and callus formation (2.13%, 2.37 score respectively). This system is still being working at our laboratory conditions to improve the regeneration capacity.

Key words: Sunflower, *in vitro* regeneration, callus shoot root formation.

PART III: CLASSICAL BREEDING METHODS UTILIZING WILD SPECIES

DIVERSIFYING GERMPLASM AS A BASIS OF GENETIC PROGRESS IN SUNFLOWER, FOR DROUGHT TOLERANCE, IN THE CONTEXT OF CLIMATE CHANGE

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The interspecific hybridization method gives to the breeders the opportunities to introduce desirable genes from wild sunflower species into cultivated sunflower. *Helianthus argophyllus* is a sunflower wild specie which can to provide genes for resistance to drough or to diseases. The aim of our study was to introduce in the cultivated sunflower, genes for resistance to dry conditions from this wild specie. The experiment started in the field with crossing of 21 sunflower inbred lines with two accessions of *Helianthus argophyllus*, in 2008 year, reciprocal crosses. We have used the embryorescue method to accelerate the breeding process. It was obtained two complete generations / year. It was released four generations of backcrossing and three generation of selfpollination, in period of 2008-2011. In each generation of the selfpollination it was tested the resistance to drough, in the green house. The degree of the cross compatibility between *Helianthus argophyllus* and *Helianthus annuus* was relatively high regardless the two types of crosses and the two accessions of the wild specie. A good number of hybrid seeds was produced, specially in case of using the wild specie as pollen donor in both accessions of *H. argopyllus*, in almost all hybrid combinations. The seed set on the head was low, in both directions of hybridization. It was obtained enough seeds for 6 combinations in case of using as mother the cultivated sunflower and for 2 combinations, too, in case of wild mother. The seed yield in each combination having as father the wild specie was higher comparing with mother line. All these eight combinations will be planted in the field, in two ecological farms situated in the most affected areas by drough, in order to select the best ones. Some combinations which have a very good resistance to drough will be used for obtaining some new inbred lines. Diversifying the genetic basis in the breeding sunflower germplasm, for resistance to drough, it gives us the possibility to have a good genetic progress which can to help us in controlling sunflower seed yield, in context of changing in the climatic conditions.

Key words: sunflower; wild species; drough; hybridization; genetic progress.

This research was financial sustained by the World Bank and Romanian Government (Grant MAKIS project, 141 554)

CREATING NEW GENETIC VARIABILITY IN SUNFLOWER USING INDUCED MUTATIONS

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The objective of the study was to provide genetic variability in agronomically important traits that can be exploited for improvement of sunflower production. Seeds of several sunflower inbred lines from gene collection of Institute of Field and Vegetables, Novi Sad were irradiated with gamma rays (*γ*) and fast neutrons (*Nf*) and with ethyle-methane-sulphonate (*EMS*) solution. Twenty one mutant lines were isolated from M_3 generation, in terms of changed oil quality, oil content, early maturity, plant height and branching. The stable progenies were evaluated in micro-plot tests in M_6 generation for seed yield and other traits in comparison with respective original line. Further studies should be focused on testing new mutant lines in hybrid combination, as well as investigate inheritance of mutant traits.

Key words: sunflower, inbred lines, induced mutation, agronomic traits

UTILIZING FROM WILD TYPES IN SUNFLOWER BREEDING FOR NEW PLANT DESIGN AND ANATOMY FOR HIGH YIELD PERFORMANCE

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Sunflower is one of the main oil crops in the world. Sunflower is growing mostly in drylands and and as summer crops so it frequently influences from climatic and environmental condititions. Sunflower yield was increased drastically after discovering CMS and restorer lines and then entering of hybrids in the production mainly at the 80s years. However, sunflower yield is a stable level in last 20 years although many new cultivars developed and introduced to market in this period. At the same time, corn yields have doubled since 1990 with developed new hybrids. Sunflower breeders should investigate this lack of heterosis both genetical bakcround and also re-analyzing plant physiology and anatomy. This difference between corn and sunflower could be result of using same CMS sources to obtain hybrids in sunflower. Therefore, sunflower plant needs new plant design utlizing from land races, interspecific hybrids and wild species. Sunflower has a bigger potential then corn because *Helianthus* genus is very large and has 51 sub species keeping very valuable traits for breeders. Seed yield is mostly related to 3 main characters: plant number per ha, seed per plant and seed weight. As physiologically, these traits mostly are related to higher photosynthesis, nutrient uptake and water use efficiency rate, etc.. From the plant anatomy side; these are larger leaf area, heads, higher plant height, longer seeds, etc.. Based on these parameters; beside of plant number: firstly to increase plant biomass, it should be developed plants have larger leaf areas and higher height plants or having leaves less petiole and short plant angle so less diameter of plants. Then, it could be increase the plant number per ha without decreasing leaf area. In these criteria; *H.divaricatus, H.californicus, H. floridanusi, H. maximiliani* has very suitable narrow and longer leaves and shorter petioles. Beside of seeds per plant: to have larger heads cultivated hybrids influence less from stres at critical periods so drought and stress tolerance genes could be transferred from *H. deserticola, H. anomalus*, etc. For heavy seeds: Firstly, similarly in previous trait, in seed filling period, drought and stress tolerant lines less influence and higher seed weight. Beside, without decreasing seed numbers at head, seed lenght should increase (with less husk content) utilizing from wild types and land races. Of course, to increase seed wieght, higher oil content is another factor and some OP varieties and wild species such as *H. niveus* and *H. salicifolius* has very valuable sources for higher oil content. As results, with new plant design and increasing leaf area, new hybrids could catch higher heterosis on seed yield.

Key words: Sunflower, Plant remodeling, Heterosis, Wild *Helianthus*, Seed yield, Leaf area, Petiole,

RESULTS OF THE SCIENTIFIC PROGRAM FOR SUNFLOWER BREEDING

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For the last 10 years in Ukraine the assortment of sunflower hybrids has been essentially changed. The oil-processing plants utilize the seed of hybrids having a modified composition of fatty acids. Diversification of theoretically grounded investigations, dealt with the using of mutant forms with the oleic acid content (90-95 %), made its contribution. A portion of the hybrids with Nusun type in 2012-2013 ys can reach 20-25 %. Owing to intermediate inheritance of linoleic and oleic acids a biological “doctor” in sunflower raw material was created in field conditions. The total number of hybrids of Kharkiv selection is 30 innovations, among these 10 are of oleic, 2 – of palmitic and 18 – of linoleic types. In the state trials of Ukraine and Russia there are more than 35 hybrids with different vegetative periods, grain yield and resistance to downy mildew and broomrape. A separate group of stearic and palmitic hybrids with the contents of stearin up to 16 % and of palmitin up to 22 % has been initiated. In the working collection of our breeders there are more than 100 maternal and 1490 paternal forms. The conditions for a wide recombination of the genotypes have been created to develop experimental hybrids and trial them in different ecological areas both in Ukraine, Russia and other foreign countries. Research coordination has made possible to create the prerequisites for sunflower germplasm examination in the research institutions of NAAS (PPI nd. a. V.Ya. Yuryev, SGI NCSP, IOC. Checking of combining ability in linear materials, sterile analogues and pollen fertility restorers has permitted transferring 10 hybrids of joint selection by PPI and SGI, and 2 hybrids – PPI +IOC, and 2 hybrids – IOC+ SGI to State Variety Test. The created hybrids are ideal for plant height (145-160 cm), head’s diametre (17-22 cm), grain yield in competitive trials (3,9-4,5 t/ha), oil content (48-56 %), oleic acid content-from 60 to 88 %, resistance to downy mildew and the major races of broomrape (Orobanche cumana). The study of the experimental material with higher content β and γ tocopherols is being conducted; the lines resistant to eurolighting and granstar are being developed as well. For the last 10 years industrial seed production of more than 27 hybrids has been initiated. In 2011 the Institute provides monitoring of major industrial hybrids’ growing (Yason, Oskil, Dariy, Kyi, Zorepad, Boyets, Svitoch, Kvin, Kapral and others) on the area above 15.000 ha of hybridization plot that provides the seed with 1,8-2,0 milion planting units of one of the most important oil crops.

CLASSIFICATION OF JERUSALEM ARTICHOKE ACCESSIONS BY DISCRIMINANT ANALYSIS OF MINERAL CONCENTRATION IN TUBERS AND LEAVES

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Discriminant analysis (DA) was used to classify 139 accessions of Jerusalem artichoke (*Helianthus tuberosus* L.). Analysis was performed using mineral element concentrations of tubers and leaves for N, P, Ca, Mg, K, Fe, Mn, Zn and Cu. Higher classification accuracy was obtained using tuber (92.8%) than leaf (78.3%) mineral concentrations. Elements that contributed the most to discrimination were Zn, Mg, and Cu for tubers and P, Mg, Zn and Cu for leaves. Accession separation in DA figures was acceptable. Three distinctive groups were found according to tuber mineral concentrations that matched accession origins from USA, Montenegro and cultivars. Leaf mineral concentrations provided a DA graph where accessions from Montenegro and cultivars were grouped in two distinctive groups while accessions from USA overlapped mostly with cultivars and to a certain degree with Montenegrin accessions.

Key words: mineral concentration, genetic variability, *Helianthus tuberosus*, tubers, leaves

PART IV: INTERSPECIFIC HYBRIDIZATION

STUDY OF HYBRID MATERIAL ORIGINATED FROM INTERSPECIFIC CROSSES WITH WILD *HELIANTHUS ANNUUS* FOR RESISTANCE TO DISEASES AND PARASITE BROOMRAPE

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Hybrid plants were obtained by crossing between five male sterile sunflower lines and 40 accessions of wild annual species *Helianthus annuus* L. form the collection of wild sunflower species in DAI, General Toshevo. Resistance of F_1 and F_2 hybrid plants to the cause agents of gray spots (*Phomopsis helianthi* Munt.-Cvet. et al.) and black spots on sunflower (Phoma macdonaldii), Alternaria leaf spot, downy mildew (*Plasmopara helianthi* Novot.) and the parasite broomrape (*Orobanche cumana* Wallroth) was studied. Some morphological, phenological and biochemical characters were established. Data obtained from the quarantine plots and in laboratory conditions showed that plants from some of the crosses were with resistant type of reaction to one or more diseases. Differences in morphological characters were observed between plants from different crosses and among plants from one and the same cross. Transfer of fertility restorer genes for the CMS PET1 was established.

Key words: Hybridization – Resistance – *Helianthus annuus*

NEW SUNFLOWER FORMS, LINES AND HYBRIDS, OBTAINED BY HYBRIDIZATION BETWEEN CULTIVATED SUNFLOWER AND ACCESSIONS FROM DIFFERENT *HELIANTHUS* SPECIES

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In the investigation were included sunflower hybrid forms, obtained by hybridization between cultivated sunflower and accessions from different *Helianthus* species. Studies were carried out under field and laboratory conditions. Self-pollination, sib-pollination, backcross and selection of hybrid plants in all generations on different characters and quality characteristics were implemented. From the obtained hybrid material, some new and interesting for sunflower breeding forms and lines were developed. Some lines were with high seed oil content and good combining ability. Some of them were parental lines of the hybrid cultivars Musala, Mura, Maritza, Mesta and Magura. Lines with large seeds or with small colored seeds were created. On this base hybrid cultivar Madan was created, with large seeds and high protein content in the kernel. Hundreds of hybrid combinations were created, considerable part of which showed high productivity. The seeds of hybrid combinations oil type were with high oil content and lines possessed resistance to some of diseases as well to the parasite broomrape. The group of hybrid combinations with large seeds and with small colored seeds was enriched. Ornamental forms with different leaf forms, different coloration of disk and ray florets were obtained.

Key words: sunflower, *Helianthus*, lines, hybrids.

PART V: GENETIC RESOURCES FOR IMPORTANT YIELD TRAITS

SUNFLOWER GENETIC AND CHARACTER COLLECTIONS AT VIR

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The study of sunflower genetic diversity in the field and laboratory conditions conducted for many years resulted in the composing of sunflower genetic and character collections. The genetic collection includes 189 lines with different manifestation of morphological characters; 120 pollen fertility restorer lines, 20 *cms* lines and their fertile analogues and 33 lines with genes for resistance to two races (330 and 730) of downy mildew (*Plasmopara halstedii* (Farl.) Berl. and de Toni), 12 of which possess resistance also to race 710. The Mendelian genetic analysis was applied to study genetic control of short stem, shape and colour of leaf blade, lower branching, colour and shape of the ray and tubular flowers, as well as pollen colour. Three types of *cms* are represented in the VIR collection, that is, the traditional PET1, RIG0 obtained on the basis of wild *H. rigidus* (Cass.) Desf., and PEF on the basis of *H. petiolaris ssp fallax*. Sterile analogues of VIR109 and VIR151 lines have been created on the basis of PET1 and RIG0. The use of *orfH522*, an mtDNA marker characteristic of *cms* PET1, made it possible to genetically identify lines with different *cms* types, as well as to obtain data on fertile or sterile cytoplasm. It was found that out of 38 analyzed *Rf*1 gene donors, 4 had been created the basis of fertile cytoplasm, 22 are based on PET1, and 13 have sterile cytoplasm that differs from that of PET1. It should be noted that all the mentioned lines restore pollen fertility to F_1 hybrids with *cms* PET1 lines. The ability of these lines to restore pollen fertility to the *cms* forms at the phenotypical level has been compared with the data from the molecular-genetic analysis that employed SCAR markers HRG01 and HRG02 tightly linked with the *Rf1* gene. The character collection is a collection of accessions characterized by the inherited manifestation of a character with a complex genetic control. Neither the number of alleles determining it, nor the level of their homozygosity are known. The sunflower character collection includes 62 accessions resistant to *Phomohsis helianthi* Munt.-Cvet., 40 large-fruited forms, 45 forms differing in plant heigh and 20 lines of ornamental sunflower. The present research was partially supported by a grant from the Russian Foundation for Fundamental Research (Project 08-04-90112-Mol_a)

Key words: collection, genetic diversity, morphological characters, CMS lines, Rf lines, large-fruitedne

ROOT CHARACTERS, ISOTOPE DISCRIMINATION, PHYSIOLOGICAL AND MORPHOLOGICAL TRAITS AND THEIR RELATIONSHIP TO IDENTIFY THE DROUGHT TOLERANT SUNFLOWER (*Helianthus annuus* L.) GENOTYPES

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To study the drought tolerance, root characters are the important traits associated with water acquisition. It is difficult to extract the roots from the field grown plants to study the root traits. Therefore, an experiment was conducted with 65 sunflower entries including CMS-lines (30), R-lines (21), inbreds (8), hybrids (9) and varieties (5) grown in temporary cement root structures using cement blocks with a dimension of 18m length, 3m width and 1.2m height. During the active vegetative growth, several physiological parameters were recorded. A small quantity of leaf sample was collected for the estimation of $\Delta^{13}C$ by Isotope Ratio Mass Spectrometer. At flowering side walls of the structure were dismantled and plants were removed carefully along with roots to record observations on root traits. Results showed a wide and significant genetic variability for leaf area (cm^2/pl), specific leaf area (cm^2/g), plant height (cm/pl), SCMR, root length (cm/pl), root dry weight (g/pl), root volume (cc) and total dry matter (TDM) (g/pl). $\Delta^{13}C$, a surrogate approach to quantify water use efficiency also showed a significant variability. Since our major objective was to look for genetic variability for drought tolerant traits and to select lines with superior drought tolerant lines, the entries were grouped into high and low root, TDM and $\Delta^{13}C$ types. Promising sunflower entries were selected based on high TDM with better root system and low $\Delta^{13}C$ to use them for heterosis breeding to develop drought tolerant hybrids. In all the entries screened, how the TDM and its components are related to each other was examined by correlating many growth parameters with TDM. The results revealed that, a positive and significant relationship between total leaf area and TDM was found; indicating the biomass production in sunflower lines depends on the total leaf area. Similarly root dry weight also showed a significant positive relationship with TDM to indicate that TDM depends on the root weight apart from stem weight and total leaf area and similar graph was obtained between root length and root volume also. However, $\Delta^{13}C$ values neither related to TDM nor to root dry weight. This may not be a major parameter to select drought tolerant sunflower lines.

Key words: Drought tolerance, isotope discrimination, sunflower, water use efficiency.

SUNFLOWER (*Helianthus anuus* L.) GENETIC RESOURCES OF TURKEY

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Plant genetic resources are currently of great interest in as much as they are related to the satisfaction of man's basic needs and to the solution of severe problems such as hunger and poverty. The conservation of plant genetic resources is necessary for the sustainable protection of genetic diversity. Because Turkey encompasses areas major centers of crop diversity and centre of origin for globally significant crops, fodder plants and forages. Landraces of many of these crops are still used within traditional farming systems and pasture the crop wild relatives and endemic species are found in their natural habitats in the rangelands and forest areas which occupy different ecosystems. Flora of Turkey consists of high endemism about 3000 out of the 9500 plant species. Turkey is described as microcenters for many crops also. The importance of the protection of existing plant diversity is highly recognized and various conservation programs exist. The National Plant Genetic Resources and Plant Diversity Program (NPGRDP) operate under the coordination of Aegean Agricultural Research Institute (AARI) of Ministry of Agriculture and Rural Affairs (MARA) involves *ex situ* (since beginning of 1960s) as well as *in situ* conservation, including on farm conservation (since 1990s). The new uniform and high yielding varieties used in modern agriculture causes the erosion of genetic diversity of landraces, old and local cultivars. The collection and characterization of those genetic resources become very essential. Sunflower (*Helianthus annuus* L.) is one of the important oilseed crops for Turkey and sunflower landraces have significant diversity in Turkey as being one of the "Micro-Gene Centers" for sunflower. The existing sunflower landraces were collected within the framework of NPGRDP and maintained long term as *ex situ* at National Gene Bank and characterized for better understanding the eco-geographic variation of sunflower landraces throughout region and for assessing sustainable utilization of those collections. The genetic resources of Turkey, eco-geographical distribution of sunflower landraces and the characterization result of agro-morphological variation of National sunflower collection will be presented.

Keywords: Sunflower, *Helianthus annuus* L., *Ex situ* conservation, diversity, agro-morphological variation, eco-geographical variation.

THE BEHAVIOUR OF SOME ROMANIAN AND FOREIGN SUNFLOWER CULTIVARS TO THE MAJOR PEST AGENTS IN THE DOBROGEA AREA

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The behavior of some sunflower cultivars against major pests were studied under natural contamination conditions at SC Sport Agra SRL ,Amzacea- Dobrogea. The pathogens which cause diseases in: germination-emergence-seedling stage: *Plasmopara halstedii Sclerotinia sclerotiorum, Botrytis cinerea,* and in vegetation periods: *Sclerotinia sclerotiorum, Phomopsis helianthi (Diaporthe), Phoma macdonaldi,Alternaria helianthi*. One of the most dangerous parasites on the plants in Dobrogea area it is Broomrape (*Orobanche cumana)*. It was shown a significant dissemination, especially in the south and south-eastern area of Romania. Best result for the major pest agents have showed :, Festiv, Turbo, Arena, PR 64 A 83, Sany, Flores and., Sunay, , For the control of the soil pests (*Agriotes sp., and Tanymecus dilaticollis)*, it has been used imidacloprid 600 FS for the seeds treatment, a systemic insecticide with a high efficacy. It was studied the influence of specific herbicides on sunflower crops.

CHARACTERIZATION AND EVALUATION OF SUNFLOWER GERMPLASM (*Helianthus annuus* L.)

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The current study aims to estimate the amount of genetic variability, heritability, and expected genetic advance for yield and yield components and characterization of the germplasm accessions based on the qualitative characters. Two hundred and eighty nine germplasm accessions of sunflower were evaluated and characterized for yield components. The germplasm accessions were characterized as per the conduct of the test for DUS on sunflower by PPV and FRA government of India. Under characterization for high seed oil content thirty four accessions, for white pollen colour nine accessions, for presence of plant branching thirty three accessions, for presence of seed stripes total forty two accessions, for high hull content four accessions were grouped and recorded. Highest phenotypic and genotypic coefficients of variation were recorded for 100-seed weight, followed by seed yield, number of filled seeds per head, plant height and head diameter. Heritability was highest for 100-seed weight (74.0 %), followed by seed yield (70.87 %), number of filled seeds per head (63.66 %), oil yield (68.23 %), and oil content (58.0 %). Genetic advance as per cent of mean was highest for oil yield (52.0 %), followed by seed yield (51.6 %) and number of filled seeds per head (35.7%). From the identified accessions a gene pool can be generated by combining the traits of the best lines from the collection. Such material could be used as a base population for selection to develop desirable populations and lines in sunflower breeding programme.

EVALUATION OF DROUGHT RESPONSE OF SUNFLOWER SYNTHETIC VARIETIES / LINES

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Sunflower (*Helianthus annuus* L.) is an oil seed crop and its growth is limited by rainfall. The objective of this work was to investigate drought tolerance of seven sunflower synthetic varieties/lines developed at Suranaree University of Technology. Seeds of seven sunflower synthetic varieties/lines and one commercial hybrid variety, pacific 77 (medium drought tolerant), were tested at three water stress levels: zero (control), -0.6 and -1.2 MPa, using polyethylene glycol 6000 (PEG-6000). Fourteen days after germination, dry matter stress index (DMSI), plant height stress index (PHSI), root length stress index (RLSI) and relative water content (RWC) were determined whereas germination stress index (GSI) was examined at 10 days after germination. The results found that PEG-induced water stress significantly decreased in GSI, DMSI, PHSI, RLSI and RWC with increase in water stress in all sunflower genotypes. S473, S471, S475 and Pacific 77 were the most tolerance under drought condition that could be selected and used for further breeding programs, whereas 5A, 6A, 9A and 10A lines were the most sensitive ones.

Keywords: Drought stress, sunflower, germination, stress index

PART VI: GENETIC RESOURCES FOR SEED AND OIL QUALITY, WEED, DISEASE AND INSECT RESISTANCE

PERFORMANCE AND SEED QUALITY OF LOCAL MOROCCAN SUNFLOWER VARIETIES AND SPANISH LANDRACES USED FOR CONFECTIONARY AND SNACK FOOD

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Sunflower seeds are one of the most important sources of vegetable oil in the world. Additionally, they are used for confectionary and snack food as well as for bird and pet food. Sunflower germplasm used for food differs between Morocco and Spain. Whereas sunflower seeds used for food in Morocco are mainly obtained from oilseed cultivars with black achenes and high oil content, those used in Spain derive from confectionary cultivars and landraces with black and white striped achenes and low oil content. The objective of this research was to evaluate the performance and seed quality of Moroccan and Spanish sunflower germplasm used for food. Six cultivars from Morocco and six landraces from Spain were evaluated in replicated field trials in Meknès (Morocco) and Córdoba (Spain) in 2009. Seed yield, oil content, achene weight, kernel percentage, fatty acid profile, tocopherol content and profile, and phytosterol content and profile were measured. Differences between cultivars were observed for most of the traits, though such differences were not always related to the cultivar type, i.e. oilseed vs. confectionary.

ANALYSIS OF FATTY ACID PROFILE AND TOCOPHEROL CONTENT OF COLD PRESSED SUNFLOWER OILS DERIVED FROM DIFFERENT HIGH OLEIC GENOTYPES

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Our research team was commissioned by the Hungarian Central Agricultural Office for quality analysis of different sunflower genetic materials applied into official trials (high oleic assortment; very early, early and medium groups) in Hungary in 2010. Thirteen genotypes of different seed companies were sown in twelve locations and the yield of two repeats was examined. Oil content was weighed after cold pressing of seeds. Oleic acid content was determined with gas chromatography while alpha-, beta-, gamma- and delta-tocopherol contents were measured using reversed phase high pressure liquid chromatography. Every material proved to be stably rich in oleic acid up to 85 per cent. Total tocopherol content varied between 195 and 928 $mg \cdot l^{-1}$. After statistical evaluation of results, we can conclude that there were significant differences among the genotypes and the locations as well. Interactions between genotypes and locations gave also noticeable information.

Key words: sunflower, oleic acid, tocopherol, cold pressing

GENETIC COLLECTION ON FATTY ACID COMPOSITION OF SUNFLOWER SEED OIL

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Development of genetic collection is considered to be an essential part of genetic resources of cultivated sunflower. There are 50 constant inbred lines in the VNIIMK collection belong to the high oleic, increased oleic, normal, low oleic, high palmitic and high oleic/palmitic phenotypic classes. The normal line RIL100 was shown to contain a high oleic mutation *Ol* in hypostatic condition. In F_2 of LG28×RIL100 the high oleic recombinants were observed with the frequency of 8%. Inheritance of the high oleic mutation in the crosses of LG26 with K1587 and VIR721 fitted monogenic dominant model in F_1, F_2 and F_3. This phenomenon is called as resistance of *Ol* mutation against a suppressor. Inheritance of the high oleic mutation in the crosses of VK508 with suppressors in F_2 fitted a digenic model of epistatic action of *Sup* over *Ol* in the ratio of 13 normal : 3 mutant. Combination of K1587×VK508 showed in F_3 the lack of homozygote high oleic populations whereas in VIR721×VK508 the mutant seeds were disappeared.

Keywords: oleic, linoleic, palmitic acids, gene

PHYTOSTEROLS IN THE SEEDS OF WILD SUNFLOWER SPECIES

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Ingestion of phytosterols prevents intestinal absorption of cholesterol in humans and results in a lowering of serum cholesterol, which has stimulated the use of phytosterols as enriched food ingredients in functional foods. Sunflower seeds and oils are rich sources of phytosterols. The variation reported for these compounds in cultivated sunflower germplasm is low. As for many other traits, wild sunflower species may contain valuable unexplored variation for phytosterol content and profile. The objective of this research was to evaluate variation for seed phytosterols in a set of 47 wild *Helianthus* species from the USDA-ARS collection. An impressive variation was identified for total phytosterol content (1017 to 4308 mg kg^{-1} seed) and proportion of individual phytosterols, particularly campesterol (5.1 to 16.3%) stigmasterol (3.1 to 23.9%), beta-sitosterol (35.1 to 72.3%), delta-5-avenasterol (1.9 to 20.5%), delta-7-stigmastenol (1.1 to 20.3%), and delta-7-avenasterol (0.3 to 10.6%). Some of the extremes of these ranges of variation have not been identified in cultivated sunflower. The feasibility of transferring genes determining interesting phytosterol traits to cultivated sunflower should be investigated.

EVALUATION OF SOME ANNUAL WILD SUNFLOWER SPECIES FOR RESISTANCE TO BROOMRAPE

B. Dedić, S. Terzić, S. Tančić, J. Atlagić, J. Mrđa, V. Miklič

Broomrape is a major constraint for sunflower production in infested areas. Appearance of new more virulent races proves that the parasite easily adapts to hybrids with new sources of resistance. Therefore, research with the aim of finding new sources of resistance is vital. This research has been conducted to test for potential resistance of accessions from the collection of wild sunflower species. Test was performed in the field where sunflower crop was heavily infested with broomrape in the previous year. Furthermore, germplasm was selected for field testing based on a test in greenhouse in pots. Resistance was confirmed for 4 accessions of *H. petiolaris,* 2 of *H. praecox* and 1 of *H. neglectus* of the total 48 tested accessions. Other tested accessions differed greatly in response to broomrape attack based on number of plants parasitized by broomrape and intensity of attack.

Keywords: wild sunflower, broomrape, resistance

SOURCES OF RESISTANCE TO THE LEAVE PATHOGENES CAUSE GREY (*PHOMOPSIS HELIANTHI*) BROWN (*ALTERNARIA SP*.) AND BLACK (*PHOMA MACDONALDI*) SPOTS ON SUNFLOWER

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The presented results are from phytopathological investigations carried out with the wild species Helianthus argophyllus and its hybrid progenies, obtained from crosses with five male sterile lines of cultivated sunflower, created in DAI. It was established the presence of resistance to grey (Phomopsis helianthi), brown, (Alternaria sp.) and black (Phoma macdonaldi) spots on sunflower. The investigations were carried out in the infection field of Dobrudzha Agricultural Institute during 2008 – 2010. As a result from self-pollination and purposeful selection some new hybrid forms were developed; they combined high resistance to some pathogens with valuable economic traits. Some morphological, phonological and biochemical characters were also studied.The obtained materials possess resistant genes and can therefore be either successfully included in the breeding programs of DAI for developing the new genetic material or be used as donors for developing new hybrid combinations.

Key words: sunflower, resistance, grey spots (Phomopsis helianthi),broun (Alternaria sp.) black spots (Phoma macdonaldi).

POSTER SESSION

PART VII: MOLECULAR BREEDING METHODS

SSR-MARKERS TO SUNFLOWER LINES AND HYBRIDS GENETIC DIVERSITY INVESTIGATION

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A microsatellite marker system was used to research a genetic diversity and allelic composition variable loci of Ukrainian sunflower breeding lines and hybrids that were created in last five years. Allelic characteristics of 15 microsatellite loci of 28 hybrids and 13 inbred lines of sunflower were found. Low level of genetic diversity of investigated breeding lines were obtained: 2,9 alleles in locus and PIC 0,48. For 24 hybrids unique allelic composition were obtained. Germ plasma of three Ukrainian breeding centers was characterized by some unique alleles with definite frequency of appearance. It was evidenced of original breeding programs and suitability to certain growing zones.

Key words*:* DNA-markers, genotyping, genetic diversity, microsatellites

PART VIII: CLASSICAL BREEDING METHODS UTILIZING WILD SPECIES

GENETIC CONTROL OF OLEIC ACID CONTENT AND DEVELOPMENT OF SUNFLOWER HYBRIDS OF NUSUN TYPE

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The possibility of genetical control of saturated and unsaturated fatty acids content in sunflower oils hasbeenproved in Plant Production Institute nd. a. V.Ya. Yuryev. Owing to the use of mutagenes a series of breeding entries with the contents of palmitin from 4% to 32%, palmetoleate from 4% to 20%, oleate from 45% to 95%, linoleate from 45% to 85% was obtained. The obtained results of genetic analysis say that oleic acid content in oils is controlled by either dominant alleles of several independent loci or recessive ones with a considerable contribution to dispersion of the effects of dominant genes-modifiers, and inheritance of high oleate content by hybrids is accomplished by incomplete dominance of paternal forms with a higher degree of the trait. It creates favourable possibilities as to the selection of lines and hybrids of NuSun type. The main method to a practical solution of the problem to create a biological "mixer" is the hybridization of a high oleic sunflower with the lines of a common linoleic type. The advantages of this method are in the possibility to acquire a wide genetic diversity of lines to heterotic breeding and develop competitive hybrids of NuSun type on this basis with the yield of 4,9-5,3 t/ha, oil content – 48-54%, oleic acid content 50-65%, with high resistance to downy mildew and main races of broomrape (Or. cumana). Particularly, these are such industrial hybrids, as Dariy, Bohun, Kvin, Maksymus, Oreol and others. Hybrids of NuSun type are of a particular importance because they combine higher content of oleic acid saturated fatty acids. It is stated that high contents of oleic and palmitic acids are controlled by independent genetic systems and as a result of crosses between high-oleic lines with the lines-sources of a high content of palmitic acid's glycerides the hybrids were developed which combine 70% oleate with the content of palmitate-up to 20%. The oils of such a type are going through trialing as the raw material for the production of lubricants for two-stroke engines as a substitute of high-cost synthetics and as a row material for the production of hydraulic liquid. By the carriers of genetical determinants for a high oleate content are the lines X526V, X1228V, X176V, palmitate lines – X1008V, X1012V and others, which are registered in the National Centre for gene resources of Ukraine and stored in its depository.

SELECTION OF SUNFLOWER "R" INBRED LINES BY RESISTANCE TO WHITE ROT AND OTHER AGRONOMIC ATTRIBUTES USING PRINCIPAL COMPONENT ANALYSIS

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The objective was to detect sunflower R-inbred lines with favorable performances due to white rot resistance and some agronomic attributes by Principal Component Analysis. The relative incubation period and the daily growth of white rot disease as well as the days to flowering and number of pollen grains/anther and bees/plant and the weight, number and oil content of seeds obtained from healthy principal capitula were measured on 35 R-lines grown at Balcarce in a season. The first four axes explained 74% of variability. The axis-1 was considered as the pollination feasibility and seed-yield ability of R-lines; axis-2 as the lapse of flowering and seed-oil content; axis-3 as the rate of white rot progression and axis-4 as the delay sowing-flowering. Around 40% of R-lines were well represented on plane 1-2, and 26% at planes 1-3 and 1-4. Despite further evaluations should be made, multivariate method allowed detecting some R-lines with at least two simultaneous and favorable attributes that could be used in hybrid seed production and/or transferred to F1 hybrids.

Key words: agronomic objectives, descriptive multivariate analysis, selection, sunflower R-lines, white rot resistance.

NEW CYTOPLASMIC MALE STERILITY SOURCES FOR SUNFLOWER HYBRIDS PRODUCTION IN IRAN

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Production of commercial sunflower hybrids since 1969 has been based on a single cytoplasmic male sterility source, PET1, discovered by Leclerq. Nowadays, development of new CMS sources of male sterility as well as fertility restorer systems are special interests of sunflower breeders for increasing genetic diversity and reducing the potential risk of vulnerability to different pathogens. In recent years, more than 60 CMS sources reported in *Helianthus* germplasm, but instability and lack of appropriate maintainer and restorer lines have limited their use in hybridization programs. New CMS source, ANN5, seems to be different from Leclerq source and because of environmental stability, it can be used as a tester for discovering new genes for fertility and breeding sunflower hybrids in Iran.

Keywords: Sunflower, Cytoplasmic male sterility, Hybrid

GENE EFFECT, COMBINING ABILITY AND HETEROSIS IN SUNFLOWER MORPHOPHYSIOLOGICAL TRAITS

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Four interspecies populations, originating from three annual (*H. debilis, H. praecox, H. deserticola*) and one perennial (*H. resinosus*) wild species, were used to produce 13 new CMS inbred lines, three Rf restorer lines with good GCA used as testers and their F_1 hybrids. A two-year trial with three replicates was set up using the line x tester method. The inbred A-lines, Rf-testers and F_1 hybrids differed significantly in the mean values of both studied traits. The mode of inheritance for leaf area was dominance and superdominance of the better parent and for plant height it was superdominance of the better parent. Highly significant positive values of GCA for both traits were found in inbred lines NS-G-7, NS-G-8, NS-G-9. The greatest highly significant positive SCA value was found in NS-G-6xRUS-Rf-OL-168 for total leaf area per plant and in NS-G-6xRHA-N-49 for plant height. The nonadditive gene effect had greater influence for both traits. A significant heterosis effect was found for both traits in relation to the parental average and in relation to the better parent.

Key words: sunflower, mode of inheritance, combining abilities, components of genetic variance, heterosis.

SUNFLOWER BREEDING STUDIES IN BLAKCSEA AREA

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Therefore, studies to increase vegetable oil production and to decrease current gap in Turkey are extremely important in terms of strategic and economical. But, when region potential is considered, this amount can easily increase. The main reason of these decrements was that sunflower prices could not fulfill the expectations. Depending on researches, farmers have thought that wheat sunflower parity should be twofold or sunflower yield should increase to cultivate sunflower again. So, breeding studies of high-yield variety that can adapt to region must be performed as well as cultivation technique studies must be practiced to increase sunflower yield per area. In this sense, it was taken a collaboration decision of intercorporate and made a protocol about sunflower breeding between Black Sea Agricultural Research Institute (KTAE) and Thrace Agricultural Research Institute (TTAE). Within this protocol, lines improved by TTAE will take to yield trials, promising lines will take for region yield trial and lines which have properties desired will present as a candidate for registration. The aim of the study is to improve sunflower varieties that are adaptable to region conditions, have broad adaptation capability, yield and oil rate. Thus, it will contribute to increase sunflower production and to decrease oil gap in Turkey. Joint study was begun in 2010 and the experiments were established in 2 different locations of Amasya County. In the study, materials sent by TTAE were used. The experiments were set up as a randomized complete block with four replications. Plots in trial consisted of 4 rows of 7.5 m. Row spacing was 70 cm, within row distance was 25-30 cm. In harvest, 2 rows in the centre were harvested and rows in edge were evaluated as an edge effect. Observations were performed in terms of plant length (cm), head diameter (cm), 1000 seed weight and yield (kg/da). 5 registered seeds and 15 lines were used in both locations. According to results; In adaptation-1, the lowest plant length was measured in S-009 line with 158.8 cm while the highest plant length was observed in S-004 with 196.8 cm. The highest and lowest yield values were obtained in Sanbro variety with 339.3 kg/da and in Sirena variety with 208.2 kg/da, respectively. 1000 seed weight ranged from 51.2 to 75.9 g and values of head diameter varied between 12.8 and 15.4 cm. In adaptation-2, the highest plant length was detected in S-022 line with 184.3 cm, the lowest one was determined in S-025 with 145.8 cm. The highest and lowest yields were obtained in S-018 line with 346.2 kg/da and in Sirena variety with 131.4 kg/da, respectively. Weight of 1000 seed varied between 42.8-70.7 g and values of head diameter ranged from 13.4 to 16.5 cm.

PART IX: INTERSPECIFIC HYBRIDIZATION

BIOCHEMICAL INDICES OF SUNFLOWER COLLECTION SAMPLES SEEDS, EVALUATED FOR EARLY RIPENING

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The biochemical testing of 173 selfpollinated lines, hybrids and varieties of sunflower seeds on oiliness, content of protein and free proline. The level of protein and free proline negative correlated with vegetation period length ((r = -0,5; 0,65, accordingly), between oiliness and yielding positive linkage is marked (r=0.6), were the level of free proline negative linked with oiliness ((r= -0.65). By the method of cluster analysis the collection lines of maternal form dispersed for 4 groups in dependence of protein and free proline content in seeds, on vegetation period length. The most lines number were in the early ripening group with the length of vegetation period from 92-95 days. Collection lines of paternal form dispersed in 6 clusters with seeds protein content varied from 16.5 to 20.6%, free proline content varied from 20.0 to 55.4 mg/%, vegetation period length varied from 92 to 112 days.

Key words: seeds, free proline, protein, length of vegetative period, sunflower

PART X: GENETIC RESOURCES FOR IMPORTANT YIELD TRAITS

THE EFFECT OF DIFFERENT NITROGEN DOSES ON YIELD AND YIELD COMPONENTS OF DIFFERENT GENOTYPES OF SUNFLOWER (*Helianthus annuus* L.)

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The present study was conducted to investigate the effects of different nitrogen doses (0, 60, 120, 180 kg ha^{-1}) on yield and yield components of different sunflower varieties and genotypes. The experiment was laid out by factorial arrangement using randomized complete block design with three replications in University of Ankara, Faculty of Agriculture and Department of Field Crops in 2009 and 2010. In this study, the effect of nitrogen rates on Plant Height, Head Diameter, Seed Yield, Oil Content, Protein Content, 1000-Seed Weight on different genetics of sunflower varieties were investigated. Since the year effect was significant between the two years, each year was evaluated separately. Soil analysis was done before and after the study. The results have shown that, between the genotypes of sunflower: Sanbro, Coban and Es Amira varieties were more suitable for growing under Ankara conditions among sunflower genotypes. In the first year effect of the increasing nitrogen was not significant. However, in the second year oil content was significantly increased. Results of the two year of this research, can be calculated that 120 kg N/ha nitrogen provided better results but increasing nitrogen in some sunflower genetics has a negative effect.

Key Words: Sunflower, *Helianthus annuus*, nitrogen, seed yield, oil content, nitrogen content, protein content, quality parameters.

GENETIC STABILITY IN SUNFLOWER (HELIANTHUS ANNUUS L) HYBRIDS

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Sunflower is the 2nd important source of vegetable oil in Pakistan after cotton seed and grown on 162,000 ha as spring (February to May) and autumn crops (Mid July to October) annually. sunflower has been grown successfully under different climatic and soil conditions of the country. It is mainly cultivated as a catch crop in two major cropping systems, i.e. Rice and cotton. Sunflower was introduced as an oil crop in 1960s, however, intensive research work was started with the evaluation and selection of suitable hybrids / varieties from different countries in mid 1980s. A total of 464 hybrids were evaluated under different climatic conditions (6-10 locations/season) during the period of 1985 to 2010 to select the high yielding and best adapted hybrids to local climatic and cropping patterns. However, few of them were selected recommended for general cultivation, might be due to narrow genetic base of hybrids. Eight hybrids, Hysun-33 (Pacific Seeds), SF-177 and SF-187 (Monsanto Seeds), NK-S-278, NK-277, NK-265 and NK-212 (Syngenta Seeds) and 64 A 93 (Pioneer Seeds) were selected and recommended for general cultivation due to their consistent better performance. Hysun-33 a long maturing (120 days) and tall (180 cm) and the high yielding hybrid is under cultivation on 70 % of the total area under sunflower since 1989 due to its stable genetic yield potential. It produced equally good yield of 2313 kg/ha in spring and 2166 kg/ha during autumn seasons. Moreover, it performed better under good and poor management conditions as compared to others. It is being used as check in national multi-location trials since 1988. Another hybrid, SF-187, an early maturing (110 days) and short stature hybrid (< 150 cm) was successfully grown in rice farming system of the Punjab during the period of 1990 to 2006. It had also good genetic potential under specific climatic and management conditions. It occupied 15~20 % of the area. Hybrids from Nortrup King Co., USA (NK-212, NK-265, NK-277 and NK-S-278) had almost the same genetic potential, may be due to closer genetic relationship.

Key words: Sunflower, *Helianthus annuus*, stability

GENETIC VARIABILITY AND HERITABILITY OF QUANTITATIVE TRAITS IN SUNFLOWER

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Genetic variability and heritability of traits related to yield is important information for sunflower productivity improvement. The objective of this research was to estimate genetic variability and heritability of quantitative traits. Twenty sunflower genotypes were evaluated at Suranaree University of Technology and National Corn and Sorghum Research Center, Thailand in 2010. Nine traits including days to flowering, head diameter, plant height, shelling percentage, seed size, seed yield, oil content, seed set and seeds per head were recorded and analyzed for genetic variability and heritability. Analysis of variance of all traits showed the significant differences among the genotypes. Phenotypic variation was greater than that of genotypic and environmental variations for all traits. High values of heritability were found in seed size, shelling percentage and head diameter, while low values were found in seeds per head, seed yield and plant height. The result implied that seed size, shelling percentage and head diameter should be used as selection traits in sunflower breeding programs.

Key words: Sunflower, genetic variability, heritability, quantitative traits

ROW SPACING, NITROGEN AND YIELD OF SUNFLOWER GENOTYPES IN SALINE SOIL

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In saline soils by managing the distance between planting rows (DS) and fertilization with nitrogen (N) may increase the yield.It was the objective of this study in sunflower. The planting of cv. Victoria was carried out in Montecillo, Mex of temperate climate under rain conditions on June 15. The salinity treatments consisted of 2, 4 and 7 dS m^{-1}, fertilization of 0 and 100 kg N ha^{-1} and DS of 0.80 m and 0.40 m. Biomass, yield and its components decreased with the increasing of salinity. With N and reducing DS the biomass and yield were increased. An interaction was observed between the N and DS. The highest biomass and yield of 2012 gm^{-2} and 591 gm^{-2}, respectively, was with N and DS of 0.40 m and 2 dS m^{-1}.

Keywords: *Helianthus annuus* L., biomass, seed number, capitulum area, dry matter.

SUNFLOWER BREEDING AND ADAPTATION STUDIES IN CUKUROVA REGION

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Turkey vegetable oil production is not enough for domestic consumption and this 50 % deficit supply by import. Sunflower is the main oil crop in Turkey growing mainly Trakya and Marmara Region. However, Cukurova region have been increasing sunflower production year by year in recent years. Sunflower is cultivating both first and second crop and exsist in the rotation system in especially some limited irrigation and dryland areas in the region. However, the planting and harvesting are one month early than Trakya Region and the region has very hot temperature during the growing season. To determine the suitable sunflower hybrids and inbred lines, the collaboration was started between East Mediterranean Agricultural Research Institute (EMARI) and Trakya Agricultural Research Institute (TARI) 4 years ago. TARI sunflower hybrids and inbred lines were used in the study. Firstly, candidate hybrids were determined and obtained in Edirne and Adana with crossing restorers and female lines which produce possible high yielding varieties in 2009. Yield trials were conducted in Ceyhan and Tarsus locations which represent mainly to region in 2010. 3 commercial control and 27 candidate sunflower hybrids were planted at 70 x 30 cm plant density in 4 replications based on RCBD design. in order to determine suitable new varieties for the region has been established yield trials.Varieties in yield trials, earliness (days), plant height (cm), head diameter (cm), thousand grain weight (cm), oil (%) and grain and oil yield (kg / ha) was determined as the plant characteristics. Seed yield of hybrids were measured between 1322,0 – 4490,0 kg / ha, oil contents were 38,8 – 45,4 %, 1000 thousand seed weight were 45,84 – 82,60 g, flowering days were 69 – 86 days, plant heights were 89,0 – 176,8 cm and head diameter of hybrids were determined as 17,3 – 24,1 cm. Accordingly, determining the plant characteristics high-grain yield varieties from trials and other low-yielding varieties have been identified differences. It is conducted that played a major role obtained from the differences varieties having high yield. In addition, high yielding varieties that may be well adapted to region and therefore can be used to start breeding is thought to work successfully. These genotypes that have plant properties suh as high yielding varieties were selected in trials.

Key Words: Sunflower, *Helianthus annuus*, adaptation, seed yield, oil content, yield traits.

PHENOLOGY, HARVEST INDEX AND PERFORMANCE OF SUNFLOWER GENOTYPES IN MEXICO HIGH VALLEYS

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Sunflower cultivation in highlands of Mexico is not common. The objective of this study was to evaluate the performance of genotypes for maximum production of sunflower in this region. The trial was established on June 17 with density of 4.2 plants m^{-2} in row of 0.80 m apart and 100-100-00 NPK ha^{-1}. The highest biomass was observed in Contiflor with 1717 gm^{-2} , seed yield of 223 gm^{-2}, harvest index (HI) of 13% and cycle time of 114 days (CDD). The lower biomass and yield (786 gm^{-2} and 132 gm^{-2}, respectively) were for Sunbred with 121 ddc and HI of 17%. The seed oil content was 36% and 40%, respectively. Grl-42, Odessyk, Peredovick and Victoria showed biomass, HI, yield and seed oil content between 786 gm^{-2} to 1496 gm^{-2}, 11% to 23%, 218 gm^{-2} to 240 gm^{-2}, and 36% to 42%, respectively. There is a relationship between cycle length of genotype, biomass and yield.

Keywords: *Helianthus annuus*, biomass, oil content, yield components

PART XI: GENETIC RESOURCES FOR SEED AND OIL QUALITY, WEED, DISEASE AND INSECT RESISTANCE

THE GENETIC DIVERSITY OF CONFECTIONERY SUNFLOWER ON SEED TYPES AND SOME YIELD TRAITS

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Sunflower is growing mainly for oil production in Turkey but confectionery type also has a significant planted areas (about 80.000 ha). However, confectionery sunflower production did not develop sufficiently because mostly village populations are in the production and there was no certified and high quality seed used in Turkey. On the other hand, Turkish consumers mostly prefer recent year completely white color and white with less grey stripes but there were no registered hybrids which have white color in the production yet. Trakya Agricultural Research Institute (TARI) – Edirne is National coordinator institute in sunflower research in Turkey and started a continuous project on confectionery sunflower to develop high yielding and quality inbred lines and hybrids. Many genetic materials were collected from different part of Turkey consisting village populations, local varieties to enhance genetic base of the confectionery sunflower breeding project. Although TARI confectionery program develop high yielding varieties, they should be bigger size and as much as white color. The genetic diversity of the confectionery sunflower female and restorer lines which existed in TARI breeding program on seed characteristics were examined in the study. Seed husk content (%) of females lines was changed between 33,5-63,6 % and their average was 46,6 % , 1000 seed weight (g) 51,1-101,2 g, its average was 74,9 g, seed lengths (mm) of restorer lines 10,3–22.5 mm and the average was 20,7 mm and seed widths (mm) of them was observed between 5,1-10,1 mm and their average was calculated as 7,5 mm. On the other hand, husk content of restorer lines was measured as 20,0-78,8 % and their average was 45,0 %, 1000 seed weight (g) 44,1-99,3 g, its average was 68,0 g, seed lenghts of females 15,3–34.5 and its average was 17,1 mm and seed widths of them was observed between 4,4–9,9 mm and their average was determined as 6,8 mm. Large diversity was observed both female and restorer lines on seed characteristics. Especially, longer and bigger seeds in confectionery type were preferred by consumers. Seed color of inbred lines changed from white, different color grey and black. As results, confectionery sunflower breeding program in TARI has adequate genetic diversity in breeding nursery on seed color and other seed characteristics which market request. White and high yielding and quality hybrids will develop in next years.

Keywords: Confectionery Sunflower, Seed characteristics, husk content, Seed Lenght, Seed width,

SCREENING OF WILD HELIANTHUS SPECIES FOR RESISTANCE TO HIGH VIRULENT *OROBANCHE CUMANA* WALLR., AFFECTING SUNFLOWER IN THE ROSTOV REGION OF THE RUSSIAN FEDERATION

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During the last years in the Rostov region of the Russian Federation the high virulent biotypes of broomrape have propagated, affecting both hybrids of foreign breeding, and the native sunflower assortment, which was resistant earlier. And the resistance of all known European sunflower differentials for broomrape races had been overcome, that testifies the presence in the region, at least, the races F, G, H. The search of the resistance sources is urgent. 14 samples of annual and 27 - of perennial wild sunflower from a collection of Kuban experimental station VIR were tested for the resistance against the most virulent broomrape population. From annual species only *H. petiolaris* had weak degree of affection (1-3 tubercles/plant), the others were affected in strong degree. The majority of perennial sunflower samples have shown the immunity. The perennial wild species of the sunflower of the same name that were used earlier in the research of Ruso et al. (1996) as resistant species against the Spanish populations of broomrape, show resistance also to high virulent *O. cumana*, which had propagated in the Rostov region of the Russian Federation.

Keywords: *Helianthus,* wild species, resistance, broomrape, high virulent races

CONFECTIONARY SUNFLOWER POPULATIONS COLLECTED ELBISTAN REGION FOR USING AS GENETIC RESOURCES IN SUNFLOWER BREEDING PROGRAMS

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Confectionary sunflower production has increased significantly in recent years in Turkey and the confectionery production is mostly located Middle and Eastern Anatolia. However, mainly village populations are cultivating in these areas. Although they have less potential for seed yield but they keep very valuable material for genetic resources to obtain new genes for sunflower breeding. The research was conducted to determine the diversity of these village populations on seed characteristics in and around Kahramanmaras – Elbistan region which is one the most important confectionery sunflower growing areas in Turkey. One hundred village populations were collected from the region in the study. These collected materials were analyzed for important seed traits as plant height (cm), thousand grain weights (g), shell ratio (%), grain size (cm) and grain width (cm), and other plant characteristics. Based on the results of the study; head diameter of the populations were measured between 17 - 24 cm, as 156 - 265 cm in plant height, 57 - 240 g in table grain weight, 51,2 – 88,4 g thousand grain weights, 42 – 70 % in shell ratio, 1,8 – 3 cm in grain size and 0,6 – 1.1 cm in grain width. Broad genetic distance was also determined as statistically in these collected materials. Different genetic characteristics of these materials are stored as seeds of genetic stocks. As a result, the region of different plant material collected confectionary features includes single plants. This material has been decided that suitable our country market confectionary hybrid or in open pollinated variety breeding used successfully.

Keywords: Confectionery Sunflower, Village populations, Yield traits, Seed quality and characteristics,

GENETIC DIVERSITY OF SUNFLOWER IN DROUGHT STRESS CONDITION USING ROOT SYSTEM STUDY IN CASPIAN BORDER REGION OF IRAN

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In order to determine the relation between root system characters and drought stress condition this study designed and conducted through 3 years. During first 2 years, 20 sunflower genotypes planted in North West region of Iran for two years with 3 Replication and experimental design was RCBD. To study of response of genotypes to drought resistance, 5 different indices were Used. Including: SSI, STI, TOL, MP and GMP. In third year 10 genotypes through genotypes mentioned above, selected for more study using root system characters. During root study these genotypes planted in a split plot experiment design with 3 replication, in three irrigation levels, seeds planted in special polythene sheets that were dug into soil. Finally Root length, root length density and root diameter determined. Results showed that: 1) sunflower genotypes showed significant differences in root length, and root length density at 1% and root diameter in 5%. 2) More tolerant genotypes had more root length, root length density and less root diameter. 3) the rooting density of sunflower in surface layers is higher 4)sunflower rooting depth differs with water condition

Key Words: Sunflower, Drought stress, root system, Root length, Density ,Root diameter

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