European
Weed
Research
Society

2nd International Conference on «Novel and sustainable weed management in arid and semi-arid agro-ecosystems»

Organized by

EWRS Working Group – Weed Management in Arid and Semi - Arid Climate

and

Agricultural University of Athens

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Edited by
B. RUBIN and G. ECONOMOU

7-10 September 2009

Santorini, Greece

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(In the alphabetical order)

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Weed biology, ecology and modeling
C. ZARAGOZA and A. MURDOCH.

Herbicide behavior in soils and integrated weed management in arid and semi arid farming systems: dry-land crops and irrigated crops
Y. GOLDWASSER and G. VASSILIOU.

Invasive weeds: biology, control and quarantine regulations
T. YAACOBY and A. ULUDAG

Parasitic weeds
D. RUBIALES and P. LOLAS

Herbicide resistant weeds and crops and risk assesment.
E. KOTOULA-SYKA and R.R. LABRADA

Cultural, physical and site-specific weed practices
H. EIZENBERG and G. ECONOMOU.

Administrative Organization:

Vassilios KOTOULAS and Georgios PANAGOPOULOS

PREFACE

Welcome to the 2nd International Conference on "Novel and Sustainable Weed Management in Arid and Semi-Arid Agro-Ecosystems" and to the exceptional Santorini island. We gathered here to enjoy the unique experience of sharing scientific knowledge, and collegial interactions among scientists with the common interest to increase the rate of progress in weed management in the fragile environment of arid and semi arid regions. Despite the advances in biology, ecology, physiology and plant protection, weeds continue to compete the crops and spread rapidly under the most acute conditions. Weed competition is more severe and harmful to arable crops in xerothermic environments including the Mediterranean basin. On this account, we decided to share ideas around the current status of climatic changes on the weed dispersal in order to understand their dynamic role in agroecosystems. The questions, the challenges and the goals will be put into consideration.

The scientific program contains invited lectures, plenary presentations, poster presentations, one meeting of EWRS working group on "Weed management in arid and semi-arid climate", field excursion to meet with the particular crop practices in the volcanic terra of Santorini and special social activities.

Enjoy your participation in the conference and your stay in Santorini.

The organizers

EWRS Working Group on Weed Management in Arid and Semi Arid climates

Agricultural University of Athens

SCIENTIFIC PROGRAM

Sunday 6 September

Afternoon and evening -Early Registration

19:00 – Opening Ceremony and Reception

Monday 7 September

Registration

08:30 Welcome address – **Chair: G. Economou**

Prof. A. Karamanos - Chairman of the Faculty of Crop Science, Agricultural University of Athens.

Mr. Chrysanthos Roussos Sub- Prefect of Thira

Prof. B. Rubin – Coordinator of the EWRS Working Group – Weed Management in Arid and Semi-Arid Climate.

09:00 Keynote address**:**

1. **Possible effects of climate change on the crop-weed interactions** Karamanos, A.J. , Faculty of Crop Science, Agricultural University of Athens**,** Athens, Greece **(invited).**

09:30 - Morning session

Weed biology, ecology and modeling - Chairs C. Zaragoza and A. Murdoch.

09:30-09:50

2. **Factors affecting soil sub-surface phases of purple nutsedge (*Cyperus rotundus*) development.** Naamat, T.[1,2], Rubin, B.[2] and Eizenberg, H.[1] Dept. of Weed Research, ARO, Newe Ya'ar Research Center, Ramat Yishay 30095, Israel, [2]The RH Smith Institute of Plant Science & Genetics in Agriculture, The RH Smith Faculty of Agriculture, Food and Environment, The Hebrew University of Jerusalem, Rehovot 76100, Israel

09:50-10:10

3. **Developing a temperature-light based spatial growth model for purple nutsedge (*Cyperus rotundus*).** Lati, R.[1,2], Fillin, S.[1] and Eizenberg, H.[2]. [1]Dept. of Transportation and Geo-Information, Technion - Israel Institute of Technology, Haifa 32000, Israel. [2]Dept. of Weed Research, ARO, Newe Ya'ar Research Center, Ramat Yishay 30095, Israel

10:10-10:30

4. **Can Peak-LAI be used as an appropriate index to estimate wheat performance under weed competition?** Soufizadeh, S.[1], Zand, E.[2], Baghestani, M.A.[2], Bannayan, M.[3,4] and Deihimfard, R.[3]. [1]Department of Agronomy, Faculty of Agriculture, Tarbiat Modares University, P.O. Box 14115-336, Tehran, Iran, [2]Department of Weed Research, Iranian Plant Protection Research Institute, Tehran, Iran, [3]Department of Agronomy, Faculty of Agriculture, Ferdowsi University of Mashhad, Mashhad, Iran, [4]Department of Biological and Agricultural Engineering, The University of Georgia, Griffin, Georgia 30223-1797, USA.

10:30 - Coffee break

11:00 - 11:20

5. **Studies on the role of aromatic shrubs in the inhibition of adjacent vegetation.** Kotoulas, V., Panagopoulos, G., Skouras, V., Economou, G. and Karamanos, J.A. Laboratory of Agronomy, Faculty of Crop Science, Agricultural University of Athens, 75 Iera Odos Str.,11855 , Botanikos, Athens, Greece.

11:20-11:40

6. Seedling emergence of Shepherd's needle (*Scandix pecten-veneris)* as affected by year time and burial depth. Souipas, Sp.[1], Bardabakis, Emm.[2.] and Lolas, P[1]. [1]Weed Science Laboratory, [2]Laboratory of Agronomy, Dept. of Agriculture Crop Production and Rural Environment, University of Thessaly, Volos, Greece.

11:40-12:00

7. Study the effect of plant population density and herbicide application on growth and development of mahdavy wheat in Nishabur's zone. Modarres Sanavy, S.A.M., Agronomy Department, Faculty of Agriculture, Tarbiat Modares University, Jallal-Al-Ahmad Highway, Nasr Bridge, Tehran, Iran.

12:20-12:40

8. Impact analysis of integrated weed management under irrigated eco-systems in cultivation of tropical crops in Tamil Nadu of Southern India. Govindarajan, K., Chinnusamy, C., Prabhakaran, N.K. and Janaki, P. DWSR Centre, Department of Agronomy, Tamil Nadu Agricultural University, India.

12:40 - Lunch

15:00 - Afternoon session

Herbicide behavior in soils and integrated weed management in arid and semi arid farming systems: dry-land crops and irrigated crops. Chairs - Y. Goldwasser and G. Vassiliou.

15:00-15:20

9. Barley/chickpea intercropping as an environmentally-sound tool for weed management in small scale dry land farms. Aghaalikhani, M[1]., Daryaei, F.[1] and Chaichi, M.R[2]**.** [1]Tarbiat Modares University ,Tehran- Iran, [2] Tehran University, Karaj- Iran.

15:20-15:40

10. Cover crops for sustainable weed management in a semi-arid climate pear (*Pyrus communis*) orchard in Israel. Goldwasser, Y.[1], Abrahams, J.[2], Ogany, Y.[3], Sibony, M.[1] and Rubin, B.[1]. [1]R.H. Smith Institute of Plant Sciences & Genetics in Agriculture, R.H. Smith Faculty of Agriculture, Food & Environment, The Hebrew University of Jerusalem Rehovot 76100, Israel; [2]Soil Conservation and Drainage Unit, Northern District/Western Galilee Branch Ministry of Agriculture, Yad Natan 25212 Israel; [3]Matityahu Research Station, A.R.O, Upper Galilee, 13860, Israel

15:40-16:00

11. Biological control studies on *Convolvulus arvensis* L. with fungal pathogens collected from central Black Sea region of Turkey. Tunali, B., Altıparmak, G., Kansu, B. and Kuleci, E. Ondokuz Mayis University, Agricultural Faculty, Department of Plant Protection, 55139 Kurupelit, Samsun, Turkey.

16:00-16:20

12. Possibilities for Managing Weeds in Arid Lands Using Classical Biological Control Methodology, with Emphasis on *Solanum elaeagnifolium*. Jones, W.A., Bon, M.C. and Sforza, R. European Biological Control Laboratory, Agricultural Research Service, U.S. Department of Agriculture, Campus International de Baillarguet, CS90013 Montferrier-sur-Lez, 34988 St. Gely du Fesc CEDEX, France.

16:20 - Coffee break

16:50 – Afternoon session

16:50-17:10

13. **Effects of long term irrigation with reclaimed wastewater on the efficacy and fate of ALS inhibiting herbicides.** Dvorkin, G.[1], Manor, M.[1], Sibony, M.[1], Chefetz, B.[2] and Rubin, B.[1]. [1]The Robert H. Smith Institute of Plant Sciences and Genetics in Agriculture, [2]Dept. of Soil and Water Sciences, The Robert H. Smith Faculty of Agriculture, Food and Environment, The Hebrew University of Jerusalem, Rehovot, Israel

17:10-17:30

14. **Soil application of olive mill wastewater as an ecological approach for weed control in sustainable agricultural systems.** Erez-Reifen, D.[1,2], Laor, Y.[1], Raviv, M.[1], Rubin, B.[2] and Eizenberg, H[1]. [1]Agricultural Research Organization, Newe Ya'ar Research Center, Ramat-Yishay, Israel. [2]Robert H. Smith Faculty of Agriculture, Food and Environment The Hebrew University of Jerusalem, Israel.

17:30-17:50

15. **Efficacy and selectivity of pre-emergence herbicides in sunflower as influenced by soil water conditions.** Jursík, M., Andr, J., Venclová, V. and Soukup, J. Department of Agroecology and Biometeorology, Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences, Kamýcka 129, 165 21 Prague 6 – Suchdol, Czech Republic.

17:50-18:10

16. **Persistence and degradation of herbicides in rice, maize and soybean grown vertisols of Tamil Nadu, Southern India.** Janaki, P., Meena, S. and Chinnusamy, C. DWSR centre, Department of Agronomy, Tamil Nadu Agricultural University, India.

19:30 – Visit to Winery and Dinner in a Traditional Tavern

Tuesday 8 September

08:30 – 09:00 Keynote address

17. **Direct and indirect effects of global change on species composition, invasion success and weed performance in dry regions.** Grünzweig, J.M. R.H. Smith Faculty of Agriculture, Food and Environment, The Hebrew University of Jerusalem, Rehovot 76100, Israel **(invited).**

09:00 Morning session

Invasive weeds: biology, control and quarantine regulations. Chairs - T. Yaacoby and A. Uludag

09:00-09:20

18. **Invasive Plants and Wildfires in Mediterranean Climates.** Bell, C.E. University of California Cooperative Extension, 5555 Overland Ave, suite 4101, San Diego, CA, USA 92123

09:20-09:40

19. **An expanding problem: *Bromus* spp.** Türkseven, S.[1], Demirci, M. [2], Uludag, A.[3] and Nemli, Y.[1]. [1]Plant Protection Department, Faculty of Agriculture, Ege University, Bornova, Izmir, Turkey. [2]Agrobest Group, Ulucak, Izmir, Turkey, [3]Agricultural Quarantine Directorate, Alsancak, Izmir, Turkey.

09:40-10:00

20. **The problems posed by introduced mesquite *(Prosopis* spp.) in arid and semi-arid zones and their management.** Labrada, R.R. Ex FAO Weed Officer, Via Valentino, Mazzore 38, Rome, Italy.

10:00-10:20

21. **Invasive Alien Species in Israel - how are we doing?** Yaacoby, T.[1,2]. [1]Plant Protection and Inspection Services, P. O. Box 78 Bet Dagan 50250 Israel, [2]R.H. Smith Institute of Plant Sciences & Genetics in Agriculture, R.H. Smith Faculty of Agriculture, Food & Environment, The Hebrew University of Jerusalem, Rehovot 76100, Israel

10:20-10:40

22. **May we expect “granivory” by isopods also in their original terrestrial biotopes of Mediterranean region?** Koprdova, S.[1,2], Saska, P.[1], Honek, A.[1] and Martinkova, Z[1]. [1]Crop Research Institute, Department of Entomology, Drnovska 507, 161 06 Prague 6 – Ruzyne, Czech Republic; [2]Czech University of Life Sciences, Faculty of Agrobiology, Food and Natural Resources, Department of Agroecology and Biometeorology, Kamycka 129, 165 21 Prague 6 – Suchdol, Czech Republic

10:40 - Coffee break

10:40 – 12:20 Poster Session: Chair – Travlos I.S.

Posters

23. **Evaluation of PICKIT- a decision support system for rational control of *Phelibanche aegyptiaca* in tomato- results from 2009 validation experiments.** Achdari, G., Lande, T., Smirnov, E., Hershenhorn, J. and Eizenberg, H. Dept. of Weed Research, ARO, Newe Ya'ar Research Center, Ramat Yishay 30095, Israel

24. **Resistance of Palmer amaranth (*Amarnthus palmeri*) to ALS inhibitors.** Manor, M., Levy, O., Dvorkin, G., Sibony, M. and Rubin, B. Robert H. Smith Institute of Plant Sciences and Genetics in Agriculture, The Robert H. Smith Faculty of Agriculture, Food and Environment, The Hebrew University of Jerusalem, Rehovot, Israel 76100

25. **Effect of soil wetting and drying cycles on metolachlor applied as S-Dual-Gold and as a controlled release formulation.** Goldreich, O., Goldwasser, Y. and Mishael, Y. Department of Soil and Water, Robert H. Smith Faculty of Agriculture, Food and Environment, Hebrew University of Jerusalem, Rehovot, 76100, Israel.

26. **Thoughts on the effective and integrated control of purple nutsedge (*Cyperus rotundus*) in arid and semi-arid environments.** Travlos, I.S.[1], Economou, G.[2], Kotoulas, V.E.[2] and Kanatas, P.J.[2]. [1]Benaki Phytopathological Institute, Department of Weed Science, 8 St. Delta street, GR-145 61 Kifissia, Athens, Greece, [2]Laboratory of Agronomy, Agricultural University of Athens, 11855, Botanikos, Athens, Greece

27. **Allelopathic potential of heliotrope (*Heliotropium europaeum* L.) on several crops of arid and semi-arid regions.** Travlos, I.S.[1] and Economou, G.[2]. [1]Benaki Phyto-pathological Institute, Department of Weed Science, 8 St. Delta street, GR-145 61 Kifissia, Athens, Greece, [2]Laboratory of Agronomy, Agricultural University of Athens, 11855, Botanikos, Athens, Greece

28. **Allelopathic potential of Greek oregano (*Origanum vulgare* ssp. *hirtum*).** Economou, G.[1], Travlos, I.S.[2] and Kanatas, P.J.[1]. [1]Laboratory of Agronomy, Agricultural University of Athens, 75, Iera Odos Str., 11855 Athens, Greece, [2]Benaki Phytopathological Institute, Department of Weed Science, 8 St. Delta street, GR-145 61 Kifissia, Athens, Greece.

29. **Critical period studies for weed control in beans in East Anatolia region of Turkey.** Zengin, H.[1], Coruh, I.[2], Sutay, S.[2] and Uludag, A.[3]. [1]Plant Protection Department, Faculty of Agriculture, Igdir University, Igdir, Turkey, [2]Plant Protection Department, Faculty of Agriculture, Atatürk University,Erzurum, Turkey, [3]Agricultural Quarantine Directorate, Alsancak, Izmir, Turkey.

30. **Contribution of seed vigor on competitive ability of plum tomato with weeds.** Chachalis, D.[1] Darawsheh, M. K.[2] and Khah, E. M.[3]. [1]Benaki Phytopathological Institute, Weed Science Department, 8 S. Delta, 14561 Athens, Greece, [2]National Agricultural Research Foundation (NAGREF), Agricultural Research Station of Palama-Karditsa, Greece, [3]University of Thessally, Laboratory of Genetics and Plant Breeding, School of Agricultural Sciences, Department of Agriculture Crop Production and Agricultural Environment, Fytoko Street, Volos 38446, Greece.

31. **Studies on *Euphorbia* spp. and *Sida* spp. as new emerging weed problems in cotton in Greece**. Chachalis, D. and Travlos, I. Benaki Phytopathological Institute, Weed Science Department, 8 S. Delta, 14561 Athens, Greece.

32. **Rational chemical control of puncturevine (*Tribilus terrestris*) in groundnuts.** Lande, T., Achdari G., Smirnov, E., Eizenberg, H. and Hershenhorn, J. Dept. of Weed Research, ARO, Newe Ya'ar Research Center, Ramat Yishay 30095, Israel.

33. **Studies on the biology of common purslane (*Portulaca oleracea*).** Smirnov, E., Eizenberg, H., Lande, T., Achdari, G. and Hershenhorn, J. Dept. of Weed Research, ARO, Newe Ya'ar Research Center, Ramat Yishay 30095, Israel.

34. **Long term herbicidal weed management on weed flora shift in transplanted lowland rice-rice cropping system of southern peninsular India.** Chinnusamy, C., Janaki, P. and Meena, S. DWSR centre, Department of Agronomy, Tamil Nadu Agricultural University, India.

35. **Ecobiological quantification and integrated management of *Striga Asiatica* (L.) in sugarcane (*Saccharum Officinarum*.L) planted in Alfisols of India.** Chinnusamy, C.[1] and Prabhakaran, N.K.[2]. [1,2]Directorate of Weed Science Research Centre, Department of Agronomy, Tamilnadu Agricultural University, India

36. **Sulfonylurea herbicides' residues affect sunflower (*Helianthus annuus* L.) growth: a bioassay approach.** Mansoori, H.[1], Zand, E.[2] and Baghestani, M.A.[2]. [1]Department of Agroecology, Environmental Sciences Research Institute, Shahid Beheshti University, G.C., Tehran, Iran, [2]Department of Weed Research, the Iranian Research Institute of Plant Protection, Tehran, Iran.

36B **Effective, long-term control of bindweeds and morningglories: Herbicide application on *Calystegia sepium, Convolvulus arvensis, Fallopia convolvulus, Ipomoea hederacea, Ipomoea purpurea.*** Zeidler, L.[1], Kraehmer, H.[3], Gerhards, R.[1] and Claupein, W.[2] [1]Institute of Phytomedicine, University of Hohenheim, 70593 Stuttgart, Germany; [2]Institute of Crop Production and Grassland Research, University of Hohenheim, 70599 Stuttgart, Germany; [3]Bayer CropScience, Industrial Park, 65926 Frankfurt am Main, Germany.

12:20 Visit to the Archaeological Museum (a walking distance from the hotel) + Lunch.

15:00 Afternoon session

Parasitic weeds- Chairs- D. Rubiales and P. Lolas

15:00-15:30

37. **Predicting the development of the 'hidden half' in *Orobanche* spp.** Eizenberg, H**.** Dept. of Weed Research, ARO, Newe Ya'ar Research Center, Ramat Yishay 30095, Israel. (invited).

15:30-15:50

38. **Transmission of plant viruses from a host plant to the parasitic weed *Orobanche aegyptiaca.*** Aly, R[1]., Naglis, A.[1], Leibman, D.[1], Lapidot, M.[2], Ziadna, H.[1] and Gal-On, A.[1]. [1]Department of Plant Pathology, Virology and Weed Research, Newe Yaar Research Center, ARO- Israel, [2]Department of Vegetable Research, Volcani Center, ARO, Bet Dagan 50250, Israel.

15:50-16:10

39. **Allelopathic relations in the rhizosphere between broomrapes and common weeds.** Höniges, A.[1], Hadacek, F.[2], Ardelean, A.[1] and Wegmann K.[1]. [1]Vasile-Goldis-University, Arad, Romania. [2]University of Vienna, Austria,

16:10-16:30

40. **Host-parasite interaction reveals inter- and intraspecific variation for *Phelipanche* species.** Lyra, D[1]., Economou, G[1]. and Kotoula-Syka, E[2]. [1]Agricultural University of Athens, 75 Iera Odos Str., 18855, Athens, Greece, [2]Democritus University of Thrace, Orestiada, Greece

16:30 - Coffee break

17:00-17:20

41. ***Abutilon theophrasti* a new host for *Orobanche aegyptiaca* in Israel.** Yaacoby, T.[1,2], Goldwasser, Y.[2] and Rubin, B.[2]. [1]P.P.I.S, Ministry of Agriculture, Bet Dagan, Israel, [2]R.H. Smith Institute of Plant Sciences & Genetics in Agriculture; R.H. Smith Faculty of Agriculture, Food & Environment; The Hebrew University of Jerusalem, Rehovot 76100, Israel.

17:20-17:40

42. **Metabolites isolated from pea root exudates as stimulants for broomrape species seed germination in a differential manner.** Fernández-Aparicio, M.[1], Cimmino, A.[2], Andolfi, A.[2], Evidente, A.[2] and Rubiales, D.[1]. [1]Institute for Sustainable Agriculture, CSIC, 14080 Córdoba, Spain. [2]Università di Napoli Federico II, 80055 Portici, Italy.

17:40-18:00

43. **Broomrape (*Orobanche crenata*) management in grain and forage legumes.** Rubiales, D[1]., Pérez-de-Luque, A.[1], Sillero, J.C.[2], Fondevilla, S.[3], Fernández-Aparicio, M.[1]. [1]Institute for Sustainable Agriculture, CSIC, Apdo. 4084, 14080 Córdoba, Spain; [2]IFAPA, Centro Alameda del Obispo, Apdo. 3092, 14080 Córdoba, Spain. [3]Department of Genetics, University of Córdoba, Apdo. 3048, 14080 Córdoba. Spain.

18:00

Meeting of EWRS working group "Weed management in arid and semi-arid climate"

20:30- Dinner in a traditional tavern

Wednesday 9 September

Full day field trip and visit to the volcano

Visit to Oia for the famous sunset & Gala dinner

Thursday 10 September

08:30 - Keynote address

44. **Herbicide resistant weeds and crops: A North American perspective**. Mueller, T.C. Department of Plant Sciences, University of Tennessee, Knoxville, TN, USA (invited).

09:00 - Morning session

Herbicide resistant weeds and crops. Chairs - E. Kotoula-Syka and R.R. Labrada

09:00-09:20

45. **Herbicide resistant weeds in the Mediterranean dry land farming.** Rubin, B.. Robert H. Smith Institute of Plant Sciences & Genetics in Agriculture, R.H. Smith Faculty of Agriculture, Food & Environment, The Hebrew University of Jerusalem, Rehovot 76100, Israel

09:20-09:40

46. **Characters for the in situ recognition of some *Conyza* species and glyphosate resistant populations from Greece.** Travlos, I.S.[1], Chachalis, D.[1] and Economou, G.[2] [1]Benaki Phytopathological Institute, Department of Weed Science, 8 St. Delta street, GR-145 61 Kifissia, Athens, Greece, [2]Laboratory of Agronomy, Agricultural University of Athens, 75 Iera Odos Str., 11855, Botanikos, Athens, Greece.

09:40-10:00

47. **Glyphosate resistance in *Conyza* spp. is dependent on environmental conditions.** Ben-Ami, G., Sibony, M. and Rubin, B. R.H. Smith Institute of Plant Sciences & Genetics in Agriculture; R.H. Smith Faculty of Agriculture, Food & Environment; The Hebrew University of Jerusalem, Rehovot 76100, Israel.

10:00-10:20

48. **Bio-efficacy evaluation of glyphosate on herbicide resistant corn hybrids (Event NK 603) for crop safety and weed control efficiency.** Kalaichelvi, K.[1], Chinnusamy, C.[1] and Suresh Kumar, R.S.[2]. [1]DWSRC, Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore - 641 003 and [2] Monsanto India (Pvt.) Ltd, Mumbai-400 093, India.

10:20 Coffee

10:50-11:10

49. Effect of increasing doses of glyphosate on water use efficiency and photosynthesis in glyphosate-resistant soybeans. Zobiole, L.H.S.[1,5], de Oliveira Junio, R.S.r[1], Kremer, R.J.[2], Bonato, C.M.[3], Muniz, A.S.[4] and Constantin, J.[1]. [1]Center for Advanced Studies in Weed Research (NAPD), Agronomy Department, State University of Maringá (UEM), Colombo Av., 5790, 87020-900, Maringá, Paraná, Brazil, [2]USDA, ARS, Cropping Systems and Water Quality Research Unit, Columbia, MO 65211, USA, [3]Biology Department, State University of Maringá (UEM), Colombo Av., 5790, 87020-900, Maringá, Paraná, Brazil, [4]Agronomy Department, State University of Maringá (UEM), Colombo Av., 5790, 87020-900, Maringá, Paraná, Brazil, [5]National Council for Scientific and Technology Development (CNPq), Brazil.

11:10- 11-30

50. Potential of Roundup Ready system for control of main weeds in maize in Central Europe. Soukup, J., Jursík, M., Laksarová, M. and Venclová, V. Department of Agroecology and Biometeorology, Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences, Kamýcka 129, 165 21 Prague 6 – Suchdol, Czech Republic

11:30-12:00

51. The need for weed risk assessment. Labrada, R.R.. Ex FAO Weed Officer, Via Valentino Mazzore 38, Rome, Italy (**invited**).

12:00-12:20

52. Weed Risk Assessment Exercises in Turkey. Uludag, A.[1] and Uremis, I.[2], [1]Agricultural Quarantine Directorate, Alsancak, Izmir, Turkey, [2]Plant Protection Department, Faculty of Agriculture, Mustafa Kemal University, Hatay, Turkey.

12:20- Lunch

15:00 Afternoon session

Cultural, physical and site-specific weed practices Chair - H. Eizenberg and G. Economou.

15:00-15:20

53. Site specific weed management: mapping the tempo-spatial development of purple nutsedge (*Cyperus rotundus*). Eizenberg, H.[1]. Dept. of Weed Research, ARO, Newe Ya'ar Research Center, Ramat Yishay 30095, Israel.

15:30-15:50

54. The use of flex-tine harrow, torsion weeder and finger weeder in saffron (*Crocus sativus* L.). Cirujeda, A., Aibar, J.[1], Fernández-Cavada, S. [2], Zuriaga, P. [3] and Zaragoza, C[4]. [1]Escuela Politécnica Superior de Huesca, Carretera de Cuarte s/n, 22071 Huesca. Spain, [2]Centro de Protección Vegetal, DGA, Avda. Montañana 930; 50059 Zaragoza. Spain, [3]Serv. Prov. de Agricultura y Alimentación, Gob. Aragón. C/ San Francisco 1; 44001 Teruel, [4]Centro de Investigación y Tecnología Agroalimentaria (Gob. de Aragón), Avda. Montañana 930; 50059 Zaragoza. Spain Spain.

15:50-16:10

55. Definition of the optimal resolution required for remote sensing of purple nutsedge (*Cyperus rotundus*) in Cotton. Miller, T[1]., Cohen, L[1]., Peleg, E. [1], Gilad, M. [1], Stein, A.[1] and Eizenberg, H.[2]. [1]Western Galilee Regional High school. [2] Dept. of Weed Research, ARO, Newe Ya'ar Research Center, Ramat Yishay 30095, Israel

16:10 - Coffee break

16:40-17:00

56. Mapping the weed occurrence at early stage of cotton crop using GIS. A case study in the main cotton zone in Greece. Kalivas, D.P[1]., Economou, G.[2], and Vlachos, C.E[2]. [1]Laboratory of Soil Science, [2]Laboratory of Agronomy, Agricultural University of Athens, Iera Odos 75, 11855, Botanikos, Athens, Greece.

17:00-17:20

57. **An integrated physical approach to control purple nutsedge (*Cyperus rotundus*).** Hershenhorn, J.[1], Weissblum, A.[2], Dor, E.[1], Lande, T.[1], Achdary, G.[1], Smirnov, E.[1] and Eizenberg, H[1]. [1]Dept. of Phytopathology and Weed Research, Newe Ya'ar Research Center, Agricultural Research Organization; [2]Dept. of Growing, Production and Environmental Engineering, Agricultural Research Organization.

17:20 – 17:40

58. **EcoPest: Sustainable use of herbicides in a pilot area in Kopaida, Greece.** Chachalis, D.[1], Kati, V.[1], Travlos, I.[1] and Machera, K[2]. [1]Weed Science Department, [2]Department of Pesticides Control and Phytopharmacy, Benaki Phytopathological Institute, 8 S. Delta Str., 14561 Athens, Greece.

17-40-18:00

59. **Tolerance of selected weed species to broadcast flaming**. Knezevic, S.Z., Datta, A. and Ulloa, S.. Haskell Ag. Lab., University of Nebraska, Concord, NE, USA.

18:00-1820

60. **Efficiency evaluation of manually operated weeders for integrated weed management in irrigated corn (*Zea mays*).** Prabhakaran, N. K., Chinnusamy, C. and Janaki, P. DWSR Centre, Department of Agronomy, Tamil Nadu Agricultural University, India.

18:00 - Closing ceremony

18:20 – Walk across the volcano and dinner

Friday 11 September

Departure

(1) Possible effects of climate change on the crop-weed interactions

Karamanos, A. J.

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Climate change, especially in the Mediterranean region, is expected to affect a number of factors exerting decisive impacts on plant growth and production, such as CO_2-concentration, air temperature, rainfall and evaporation distribution patterns, and frequency of extreme meteorological incidents. An increase in air temperature positively affects photosynthesis and respiration, and accelerates plant growth, although a delay in flowering may be caused in some cool-season plants. A rise in CO_2-concentration is expected to increase net photosynthesis, and water use-efficiency, mainly in C_3-plants. A decrease in the precipitation/evaporation ratio will cause more intense water stress-effects, depending on the growth stage of the species and the severity of stress. All these effects will act differentially among plant species, depending on the CO_2 assimilation pathway (C_3 or C_4-plants), the temperature (cool- and warm-season plants) and water stress-sensitivity of the plants under consideration. Apparently, these changes will also affect the composition of the weed flora and the occurrence of new invasive species, as well as the competition patterns between weeds and crops.

Weed biology, ecology and modeling

1

(2) Factors affecting soil sub-surface phases of purple nutsedge (*Cyperus rotundus*) development

Naamat, T.[1,2], Rubin, B.[2] and Eizenberg, H.[1]

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Purple nutsedge (*Cyperus rotundus*) is a noxious weed causing serious damage in irrigated summer crops. The ability to reproduce by forming underground tubers and bulbs provides this species with a unique competitive advantage over many crops. In spite of the intensive research of purple nutsedge biology, only few publications have dealt with the effect of the environmental conditions on the soil sub-surface organ development. Out of several environmental conditions and physiological factors that were studied, the current study evaluated and quantified the effects of temperature and the tuber's burial depth on the development of purple nutsedge in the sub-surface. Temperature is considered to be the main regulator of purple nutsedge's sprouting and tuber production. The effect of constant temperatures was determined and quantified in a range of 20°C to 50°C in a medium exposed to a temperature gradient. Tubers sprouted under temperature conditions lower than 45°C. Sprouting took place within 10 days from planting (DAP) and optimal sprouting and development occurred at 34°C. Sprouting rate was highly exponentially temperature related. Furthermore, the progress of sub-surface development was characterized in accordance to physiological age (growing degree days, T_{base}=10°C). A strong relation was found and was described by a sigmoid equation. Moreover, the effect of the tuber's burial depth on sprouting was determined using a minirhizotron camera. Depth did not have a significant effect on time required for sprouting and all tubers sprouted within one week. In all treatments, there was approximately 100% sprouting without any significant differences. In conclusion, quantifying mathematically the relation between environmental factors and purple nutsedge sub-surface phases was performed in order to develop a predictive developmental model. This model might be utilized as a control model to allow more efficient, economical and environmentally-friendly management of this troublesome weed.

(3) Developing a temperature-light based spatial growth model for purple nutsedge (*Cyperus rotundus*)

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Purple nutsedge *(Cyperus rotundus)* is a troublesome weed in the Mediterranean. The weed is characterized by a high photo-synthetic efficiency (C4 plant), and therefore its growth is strongly related to temperature and light conditions. Understanding its annual spatial growth can support favorable management and precision agriculture strategies. Therefore, prediction of purple nutsedge foliar spatial growth under varied temperature and light conditions, and the contribution of each factor for weed growth were investigated. Purple nutsedge plants were grown under different shading levels in five experiments through 2008 and 2009, representing wide range of temperature and light conditions. Plant leaf cover area was measured using image data. Temperature was found as a key growth factor compared to light. Under non-favorable temperature conditions, light intensity (varied by shading levels) did not affect the leaf cover area. Within optimal temperature conditions, light intensity and leaf cover area were highly related. Temperature data were converted to degree-days (DD). A weak correlation was found when purple nutsedge spatial growth was fitted to DD using an exponential model. To improve the accuracy of the model, light intensitywas added as a variable. The reciprocals of the two restricting variables were integrated into a single term called effective day-degrees (EDD). Purple nutsedge leaf cover area and EDD were highly related. These relations were found for both individual and multi-season-experimental analyses. The results found in this study can be a basis for purple nutsedge management decision system by predicting accurately its spatial growth using EDD.

(4) Can peak-LAI be used as an appropriate index to estimate wheat performance under weed competition?

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Introducing an easy-to-measure and reliable index that enables researchers and farmers to estimate the crop performance under weed infestation would be of great value. Eight field experiments were conducted at two locations, Karaj and Varamin, in Iran in 2003-2004. At each location, eight Iranian wheat cultivars were studied in competition against four weed species. Weed species were wild oat (*Avena fatua*), rye (*Secale cereale*), flixweed (*Descurainia sophia*) and rocket (*Eruca sativa*), each of which were studied in a single experiment. Leaf area index (LAI) of the wheat crop was measured destructively throughout the growing season and peak LAI was recorded. Wheat grain yield and biomass were also measured at final harvest. The ratio of weed-infested to weed-free grain yield (R) was used as a criterion for selection of successful wheat cultivars under weed competition. According to this criterion, wheat cultivars were judged from two standpoints; i.e. cultivars with the ability to tolerate weeds ($0.90 < R < 1$) and cultivars with the ability to suppress weeds ($R > 1$). The results indicated that cultivars Mahdavi and Pishtaz were able to tolerate weeds while cultivars Roshan, Pishtaz and Karaj2 were able to suppress weeds. In the latter case, the grain yield under weed-infested condition was higher than weed-free condition. It was found that cultivars Roshan, Pishtaz and Karaj2 had higher peak LAI under weed-infested condition compared to other cultivars considering all weed species and locations. Regressing wheat grain yield and biomass against peak LAI resulted in two different responses. Wheat biomass was positively associated with peak LAI while wheat grain yield was negatively associated with this index. However, the association between grain yield and peak LAI differed between weed-free and weed-infested conditions; in the latter, a linear relationship with almost constant slope was observed. Overall, it was concluded that peak LAI could be reliably used as an appropriate index for identification of successful wheat cultivars under weed infestation.

(5) Studies on the role of aromatic shrubs in the inhibition of adjacent vegetation

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The countries around the Mediterranean basin are worldwide known for their richness of the aromatic flora. Particularly, the semi-dwarf aromatic shrubs, *Coridothymus capitatus*, *Satureja thymbra*, *Origanum onites* and *Origanum hirtum* are the most common in the phytogeographical territory of Greece constituting part of the traditional Mediterranean vegetation known as “phrygana”. These species can be used as phytomedicines as the volatile essential oils produced by plant tissues have been documented for their allelopathic effects. Observations on the surrounding vegetation in the Aegean Islands, Ikaria and Fournoi, revealed that adult aromatic shrubs, of the above mentioned species demonstrate variable suppressive effects on adjacent plants. Assessing the importance of the adjacent flora, expressed as the sum of relative frequency and relative cover per 15 m^2, we obtained the following values, 5.91, 9.52, 13.33 and 13.41 for the species *O. onites, C. capitatus, O. hirtum* and *S. thymbra,* respectively. Additionally we assessed the diversity of the the adjacent vegetation taking into account the Simpson index. Furthermore, laboratory experiments were conducted in order to evaluate the inhibitory effect of herbal distillates. *O. hirtum* expressed greater inhibitory effect on the two bioindicators *Avena sativa* and *Spirodela polyrhiza* in comparison with the other aromatic species tested.

(6) Seedling emergence of Shepherd's needle (*Scandix pecten-veneris)* as affected by year time and burial depth

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The knowledge of weed biology and ecology is critical in intergraded weed management. Knowing the emergence time and the behavior of the weed seeds in the soil may help in designing a weed control strategy. Field experiments were conducted in 2007-08 and 2008-09 at the Research Farm of University of Thessaly to evaluate the effect of year, date and burial depth on seedling emergence of *Scandix pecten-veneris,* a very common broadleaf weed in winter cereals in Greece. Number of seedlings and emergence time were measured every 10 days in a natural Shepherd's needle population and a population from seeds (6 months old), which had been sowed at a depth of 4 cm every 10 days from January 1st to December 31st. In a further burial depth study, mature seeds were buried at depths of 2.5, 5, 7.5, 10, 12.5, and 15 cm (4 replications/depth) at 5 different times of the year - 24 November, 14 February, 16 March, 1 April, and 18 April. Soil temperature at 5 cm was recorded by data logger. Emergence in the natural Shepherd's needle population began 1-5 October (5-10 plant/m^2) and stopped 20-30 April, with a maximum in December (2760 plant/m^2 with mean soil temperature 7 to 10 ^oC). Higher (75-92%) and faster (17- 22 days after sowing) emergence was observed when seeds were sowed between 20 October and 1 December and on 20 February. Zero seedling emergence occurred when mean soil temperature was above 18 ^oC. Where seeds were buried deeper than 12.5 cm emergence of Shepherd's needle was significantly lower (10-34%).The results could be helpful in developing a predicting system of weed emergence and crop sowing time can be adjusted in order to avoid early weed competition. Soil tillage with mouldboard plough at 15 cm would be useful in reducing Shepherd's needle density in fields where this weed is a serious problem.

(7) Study the effect of plant population density and herbicide application on growth and development of Mahdavy wheat in Nishabur's zone

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An experiment was conducted in Nishabur's zone for studying the effect of plant density and herbicide application on growth and development of Mahdavy wheat in crop season 2007. The experimental design was a split plot with four replications. Three levels of plant population (D1 = 250, D2 = 400 and D3 = 550 plants m^{-2}) were randomized as the main plots and five herbicide treatments [T1 = clodinafop (Topic, 1 L ha^{-1}) + tribenuron (Granstar, 20 g ha^{-1}), T2 = imazamethabenz+isoproturon (Assert-IPU,4 L ha^{-1}), T3 = clodinafop (Topic, 1 L ha^{-1}) + metosulam (Sinal, 125 mL ha^{-1}), T4 = quizalofop (Pantera, 2 L ha^{-1}) and T5 = Control] were randomized as the subplots. Results showed that the most and least plant dry weights were for plots with plant population densities of 400 and 250 plants m^{-2}, respectively. T1 and T2 herbicides had the maximum and minimum effects on weed control, respectively. Weed damage in control plots was observed to 52%. Wheat grain yield did not vary with plant population density. There was a significant effect for herbicide on grain yield ($P<0.05$). The best herbicide for weed control was T1 in this experiment. The interaction between plant population density and herbicides was significant ($P<0.05$) for wheat ears per m^2 spikelets per ear, 1000 grain weight, grain number per spikelet and linear grain filling velocity. All traits except the number of spikelets per spike were unaffected by herbicides. All traits were higher in plant population density D2 than at other densities. T1 had better weed control than the other herbicide treatments. Overall, the D2-T1 treatment had the best characterization.

(8) Impact analysis of integrated weed management under irrigated eco-systems in cultivation of tropical crops in Tamil Nadu, Southern India

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Farmers use various methods of weed management including cultural, mechanical and chemical methods. Combining various weed management methods is sometimes known as integrated weed management. Studies have proved that herbicidal weed control was the most effective method. Practices must, however, be looked upon from the viewpoint of economics by studying the labour use and yield levels of crops. The objective of this study was to compare the profitability of farms that are using herbicides as one of their control measures and otherwise. The study was carried out during 2008-09 with a sample of 120 farms each using herbicide or not, covering paddy rice, maize and sugarcane. Details on cultivation aspects, yield particulars and income realized were collected from the sample farmers belonging to both the categories. Results were subjected to tabular and percentage analyses. For farms using herbicides, the analysis showed that labour usage was about 43, 33 and 80 hours lower in paddy rice, maize and sugarcane crops, respectively . Yields in farms using herbicides were also higher by about nine quintals in paddy rice, four quintals in maize and 100 quintals in sugarcane. Profits were also higher where herbicides were applied. It was concluded that application of herbicides to control weeds in paddy rice, maize and sugarcane is an efficient way of weed control in terms of labour use, yield and profits.

Herbicide behavior in soils and integrated weed management in arid and semi arid farming systems: dry-land crops and irrigated crops

(9) Barley/chickpea intercropping as an environmentally- sound tool for weed management in small scale dry land farms

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In order to estimate the effect of barley/chickpea intercropping on weed control in dry land farming condition of Alborz Province(representing a semi-arid climate) a field experiment was conducted at agricultural research station of Tehran University (Karaj campus) on 2007 – 2008. Factorial arrangement of mixing ratio of barley (*Hordeum vulgare* cv.Valfajr) and chickpea (*Cicer arietinum* cv.4322) were used to form experimental treatments. So 11 treatments consist of factorial of chickpea (50, 75, and 100 percent of pure stand) and barley (50, 75, and 100 percent of pure stand) plus two control plots (pure stand of chickpea and barley) were studied in a randomized complete blocks design with 3 replications. Seasonal dynamics of weed population were investigated using 2 permanent quadrates (50*50 cm) in each plot. Weed biomass and species frequency in pure stand and barley/chickpea intercrop were compared at end of the season. Green biomass of chickpea monoculture (220 Kg/ha) was suppressed by weed competition. This treatment produced the highest amount (619.84 Kg/ha) of weed dry matter which dominantly consisted of fumitory (*Fumaria asepala*). All the weeds were suppressed in intercrop treatments except fumitory which was alive up to flowering stage. According to weed free condition at barley pure stand and significantly decrease of weed biomass in treatments including barley, it could be concluded that barley has acceptable competition ability against weeds.

(10) Cover crops for sustainable weed management in a semi-arid climate pear (*Pyrus communis*) orchard in Israel

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The use of cover crops is an important component in sustainable agriculture with proven benefits in field crops and orchards by preventing soil and wind erosion, enhancing soil properties (aeration, fertility and moisture retention), increasing beneficial insect abundance for biological control of pests and suppressing weeds by cover crop competition, shading and exudation of phytotoxic allopathic substances. In a current field study, the efficacy of cover crops is being tested in a newly planted pear (*Pyrus communis*) orchard at the Matityahu orchard research station in the Upper Galilee region in northern Israel. Cover crop treatments were sown and established in the autumn of 2008 before the spring 2009 tree planting. Oat (*Avena sterilis*), Oat+vetch (*Avena sterilis+Vicia sativa*) and triticale (×*Triticosecale*) were seeded between the intended pear rows. Two control treatments include the standard weed management practice-herbicide applications and mowing, and mowing only of natural vegetation. Cover crop growth and weed infestation, including identification and counts of weed species are being monitored periodically. A significant suppression of spring and summer weed species was recorded in the cover crop treatment plots versus the two control treatments. Additional treatments of mowing and application of cuttings as a mulch on the tree rows vs. mowing without mulch application will be applied in the spring of 2010. The long term benefits and applicability of non-chemical cover crop and natural mulch weed management will be evaluated and the role of each component in suppressing weeds will be further examined in field and lab studies.

(11) Biological control studies on *Convolvulus arvensis* L. with fungal pathogens collected from central Black Sea region of Turkey

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Field bindweed (*Convolvulus arvensis* L.) a perennial herbaceous vine is ranked in ten worst weeds in the world. It is one of the main weeds for which adequate controls (e.g. chemicals or culture practices like ground cover) are still not available. In summer 2007 and 2008, diseased Field bindweed plants were collected from central Black Sea region of Turkey. Surveys were conducted at 26 sites and collected fungi were isolated and screened for pathogenicity. In total, 211 cultures representing 11 species and 35 genera these include, *Acremonium* sp., *Alternaria* spp., *Bipolaris sorokiniana*, *Colletotrichum* spp., *Fusarium* spp., *Macrophoma* spp., *Myrothecium verrucaria*, *Pestalotia* sp., *Phoma* spp., *Phomopsis* sp., *Phomopsis convolvuli*, *Septoria convolvuli, Stagonospora convolvuli*, etc. Field and greenhouse experiments were conducted on a *M. verrucaria, Macrophoma* sp., *Pestalotia* sp. isolated from field bindweed. Treatments of those three fungi caused some leaf diseases to seedlings. After 21 days, *M. verrucaria* caused an average of 77.3 % dead leaves, 11.3 % spotted leaves, *Pestalotia* sp. caused 16.7 % dead leaves and 14.3 % spotted leaves, *Macrophoma* sp. caused 17.3 % dead leaves and 16.0 % spotted leaves under greenhouse conditions. In a field trial, those three fungi were applied one by one and two pathogens together. Our results indicated that *M. verrucaria* is the most pathogenic fungus. *M. verrucaria* and *Pestalotia* mix were the most effective in mixed pathogens. Second trial was applied in the field. The efficacy of a second treatment will be calculated later.

(12) Possibilities for managing weeds in arid lands using classical biological control methodology, with emphasis on *Solanum elaeagnifolium*

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Exotic, invasive weeds adapted to arid lands are likely to increase their distribution in the future. Classical biological control should be considered as a management technique against selected species to reduce pesticide use and other inputs. Biocontrol of invasive weeds is not largely studied in Eurasia, but remains an ecologically sound approach to invasive species management. Silverleaf nightshade, *Solanum elaeagnifolium*, may be a very good target to initiate this kind of project. It likely is from the southwestern U.S. and Mexico and has spread around the world and is currently a serious pest in Greece and probably spreading to adjacent countries. It is the number one weed pest in Morocco and very serious in adjacent countries. *S. elaeagnifolium* economically impacts agricultural areas by competing with cereal and other agricultural crops, damaging pastures, and infesting meadows and roadsides. South Africa has previously carried out a successful classical biological control program against this weed, and thus the protocols, lessons learned and likely outcomes are largely known. Natural enemies are listed and their capability to attack and control the target plant is discussed. Special attention is devoted to two chrysomelid beetles already released with success against *S. elaeagnifolium*.

(13) Effects of long term irrigation with reclaimed wastewater on the efficacy and fate of ALS inhibiting herbicides

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In semi-arid countries including Israel, water is a limited resource and therefore there is an increased demand for reclaimed wastewater (RWW) for crop irrigation. This water contains dissolved salts, organic matter and suspended materials that might interact with herbicides and affect their activity in soil. In 2005 and 2006 farmers reported a significant reduction in herbicide efficacy in cotton fields that have a long history of irrigation with RWW. We hypothesized that irrigation with RWW enhances the microbial activity in the soil and therefore increases the biodegradation of the applied herbicides. Alternatively, we propose that the high load of dissolved organic matter in the irrigated soil may affect the adsorption and mobility of herbicides and therefore reduces their activity. Results of three field experiments (2007-2009) have shown that the activity of some ALS-inhibiting herbicides has declined faster then others resulting in high weed infestation. The level of the herbicide in the soil was evaluated using a soil bioassay with *Sorghum bicolor* as a test plant. Shoot growth inhibition has declined in RWW–irrigated soil and 20 days after application (DAA) there was no significant difference in plant shoot growth between soil containing trifloxysulfuron and the control. Greenhouse experiments conducted with trifloxysulfuron (ALS-inhibitor) confirmed that herbicide activity in the soil is significantly reduced by the irrigation with RWW compared to soil irrigated with fresh water. In future research we will investigate the possible involvement of the soil microbial population in the observed accelerated dissipation of the herbicidal activity in RWW-irrigated soils.

(14) Soil application of olive mill wastewater as an ecological approach for weed control in sustainable agricultural systems

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The fast growing olive oil industry is facing severe problems of environmental pollution due to its associated wastes. Olive mill wastewater (OMW) has extremely high organic load, high salinity and acidic nature. It also contains high concentrations of phenolic compounds and short chain fatty acids that contribute to the toxic nature of these effluents. In this study, we examined the potential use of OMW for weed control under sustainable agricultural systems. Experiments were conducted in a net house in pots filled with Vertisol type soil. Pots were sown with four weed species: *Silybum marianum, Phalaris brachystachys, Daucus carota and Synapis alba*. Three OMW application methods were examined: PPI, PRE and POST. Four levels of OMW were applied: 0 (untreated), 20, 80 and 160 m^3/ha. POST treatments did not injure weeds significantly. PRE treatments severely reduced seedling emergence of dicot species, however, minor reduction was observed in *P. brachystachys* emergence. PPI treatments moderately affected weeds emergence, yet they significantly affected weed development and biomass. The herbicidal effect of OMW was also tested under field conditions. Control plots which received no OMW, surface spreading of 80 m^3/ha (PRE) and surface spreading of 80 m^3/ha, incorporated two days later to a depth of 10 cm, using a rotary tiller (PPI). Weeds emergence was reduced when OMW was applied PRE or PPI. Moreover, weeds that succeeded to emerge were severely injured by OMW. In this study we have shown that OMW can serve as a bio-herbicide for weed control.

(15) Efficacy and selectivity of pre-emergence herbicides in sunflower as influenced by soil water conditions

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Weed control in sunflower is currently based on soil-active pre-emergence herbicides. Their effect depends strongly on soil water conditions. In dryness, their efficacy decreases; on the contrary, intensive precipitations shortly after application may cause sunflower injury due to movement of herbicide. Small plot trials were carried out in sunflower in 2008 and 2009 to evaluate the influence of rainfall/irrigation on efficacy and selectivity of commonly used herbicides (oxyfluorfen, linuron, flurochloridone, pendimethalin, prosulfocarb and acetochlor). Herbicides mentioned above were applied pre-emergence. Consequently, half of each plot (10 m^2) was treated by simulation of rain/irrigation (30 mm) at the growth stage of sunflower BBCH 10-12, second half of the plot remained untreated. Efficacy on weeds and crop injury were assessed. Zero or negligible crop injury was found on the plots untreated by rainfall/irrigation. Herbicides containing the active ingredients oxyfluorfen, flurochloridone and acetochlor caused crop injury more than 25 % when the simulation of rain followed within 2-5 weeks after application of herbicides. The symptoms of crop injury were bleaching on leaves (flurochloridone), necroses and deformations of leaves caused by drops reflected from soil surface (oxyfluorfen), and growth retardation (acetochlor). The efficacy of tested herbicides was mostly lower under dry conditions. Especially the efficacy of linuron decreased very strongly (from 90-100 % under wet condition to 0-70 % in individual species under dry condition). On the contrary, efficacy of acetochlor on *Echinochloa crus-galli* and *Amaranthus retroflexus* was not influenced significantly by precipitation after herbicide application (100 % efficacy).

(16) Persistence and degradation of herbicides in rice, maize and soybean grown in vertisols of Tamil Nadu, southern India

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Field experiments were carried out in sandy clay loam vertisols from 2007 to 2008 in order to study the persistence and degradation of common herbicides applied to rice (butachlor, pretilachlor), maize (atrazine, alachlor) and soybean (pendimethalin, metolachlor) crops at two levels of application. The soil samples at depth of 0-15 cm were collected at periodical intervals from 0 day to harvest for residue analysis. Herbicides residue after their extraction was determined using GC-ECD, except atrazine which was determined using GC-FID. The results showed that the initial deposits of herbicides in soil vary with the concentration applied and a gradual and continuous dissipation of all herbicides in the treated soil was observed as a function of time irrespective of the crops grown. The dissipation of all the herbicides from the soil followed the first order kinetics. The correlation coefficient (r^2) derived from the regression lines lies between 0.714 and 0.957 and best fit was observed for chlorine group of herbicides. Half life of the herbicides increased with the increase in its applied concentration. The mean half life of initial concentration of herbicides studied is 5.88, 12.44, 31.45, 4.78, 14.63 and 22.42 days for butachlor, pretilachlor, atrazine, alachlor, pendimethalin and metolachlor respectively. Degradation of herbicides in soil initially depends on the intrinsic properties of the herbicides, secondly on the soil properties. Within the period of crop harvest (60 days after herbicide application) more than 98 per cent of herbicides dissipated from the soil, except metolachlor and atrazine.

(17) Direct and indirect effects of global change on species composition, invasion success and weed performance in dry regions

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Global environmental change, such as atmospheric CO_2 enrichment and climate change, can significantly alter vegetation composition in drylands by differentially affecting plant species. Such differential effects result from direct impacts of climate and atmospheric composition on plants (different degrees of species adaptation to altered growing conditions) and from a series of indirect changes in the plant's environment (competitive ability of other species, changes in availability of resources, such as water, etc.). Maternal effects of global change on offspring performance and fitness can contribute to long-term impacts on species composition. Non-native invasive species are often predisposed to strong responses to altering conditions induced by global change. Particularly following increased resource availability, the often fast-growing invasive species can outcompete species that are stressed by the changed conditions. Interactions with anthropogenic disturbance, such as land use change, and positive feedback loops, e.g. by increased fire frequency and intensity, might further stimulate invasive species, particularly in dry regions. Performance of weeds might be enhanced by global change, for instance in the case of invasive weeds adapted to altered conditions. Under climate-change induced reductions in soil moisture, drought-adapted weeds or invasive species can exhaust water supply to crops or native species by a more extensive root system or by sustained stomatal opening enabled by physiological tolerance to drought. Distribution of invasive species and weeds will be changed in the future by biotic and abiotic interactions, such as disturbance and propagule pressure superimposed on changes in climate suitability.

Invasive weeds: biology, control and quarantine regulations

3

(18) Invasive Plants and Wildfires in Mediterranean Climates

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Wildfires are a regular occurrence in many Mediterranean climatic zones around the world. Many of these wildfires are caused by natural events, such as lightning. In the past several decades, however, humans have become the most common ignition source due to population increase and the expansion of human presence into wildland areas. Much of the native vegetation types, such as scrub, grassland, and savannah, are well adapted to wildfires and recover to their pre-fire state within a few years under normal conditions. The presence of non-native invasive plants, however, creates an abnormal situation that can change wildfire patterns. These invasive plants often recover quicker and expand their relative cover after wildfires; impeding the recovery of the native flora. In southern California, USA, non-native winter annual grasses (such as *Avena fatua* and *Bromus diandrus*) and forbs (such as *Brassica*, spp. and *Erodium* spp.) that senesce in summer provide easy to ignite fuels that often shortens the fire return interval relative to historical periods. If the fire return interval is too short, native shrubs and grasses can be extirpated from the habitat. Research is being conducted using herbicides to control these non-native annual grasses and forbs. This research has been successful in significantly reducing the cover of these non-natives with a concomitant increase in the cover of native vegetation.

(19) An expanding problem: *Bromus* spp.

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Turkey is one of the prominent wheat growing countries. Wheat fields cover over one third of total agricultural land of Turkey. Graminae genera such as *Avena*, *Phalaris*, *Alopecurus*, *Lolium*, and *Bromus*, are among main weeds in cereal fields. It has been observed that *Bromus* spp. have infested more fields and size of their population in individual fields has been expanding. The aim of current study is to determine magnitude of Bromus spp. problem in wheat fields in south part of Marmara Region of Turkey. In 2008-2009 cropping season, 125 fields were surveyed. Two *Bromus* species were identified: *Bromus tectorum* and *Bromus japonicus*, both are eurasian plants. *B. tectorum* was recorded in 30.4 % of surveyed fields while *B. japonicus* was found in 4.8 % of the fields as mixed populations with *B. tectorum*. It is speculated that shallow tillage techniques are the foremost cause in *Bromus* increase. Those tillage techniques have replaced plowing due to changing climate, lacking of crop rotation and increasing cost of inputs. Expanding *Bromus* populations has caused an increase in herbicide use such as propoxycarbazone-sodium + mesosulfuron-methyl, sulfosulfuron, pyroxsulam + cloquintocet-mexyl which are herbicides already registered in Turkey to control *Bromus* species as well as other weeds. *Bromus* problem should be dealt with herbicide resistance problem. In addition, *Apera* spp. should be kept under investigation in the same area.

(20) The problems posed by introduced mesquite *(Prosopis* spp.) in arid and semi-arid zones and their management

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Mesquites (*Prosopis* spp) are fast growing, salt-tolerant and drought-tolerant trees that can grow in areas with extremely low annual rainfall. Several species of these leguminous nitrogen fixing trees, such as *Prosopis juliflora* (Sw,) DC*, P. pallida* (Humb. and Bonpl. ex Willd.) Kinth, *P. chilensis* (Molina) Stuntz, *P. glandulosa* Torr., *P. velutina* Woot., *P. alba, P. pubescens* Benth. and *P. tamarugo* F.Phil., have been introduced from the Americas to several regions of Africa, Asia and Oceania to improve the environment in arid and semi-arid zones. However, due to mismanagement and insufficient exploitation, most of these species have become serious invaders of watercourses, mangroves, floodplains, highways, degraded lands, abandoned lands and irrigated areas in most of the countries where introduced. At present only in countries of East Africa, i.e. Kenya, Ethiopia, Sudan and Djibouti, the area heavily invaded by *P. juliflora* and hybrids is more than 1 900 000 ha. Other countries severely affected by these plants are Yemen, Oman, Saudi Arabia and India, where dense stands of *Prosopis* spp have replaced native *Acacia* spp.. Thorns 70-100 mm long grow along the tendrils and inflict injury to people (and especially children) when they step on them as well as animals. High sugar content of seed pods cause severe teeth decay when animals ingest them. Further, seeds pass easily through the digestive tract of animals undamaged, thereby spreading further the plant and resulting in dense stands covering fertile areas. Due to these problems it is important to conduct risk assessment of Prosopis before its introduction in a new country or territory. Knowing the history of Prosopis in several countries where it has been introduced one logical approach would be to strictly prevent the deliberate introduction of *Prosopis* plants into new areas. If *Prosopis* introduced in the past has become an invader, then it would be necessary to implement an integrated management approach. The first step here should be the quantification of the areas affected and areas where the plant is desirable to be kept. The major problem with Prosopis has been leaving the plant to spread unchecked, and not removing/using it for various purposes. The removal either mechanically or manually is the second step. Removed stands can be used for different purposes. Prosopis has potential as a source of fuelwood, timber and animal forage. Mechanical land clearance is costly and several countries in arid zones may not be able to implement it unless they receive necessary external financial support. Areas cleared should be ploughed conveniently to kill propagules to avoid further plant reproduction. Regrowth should also be removed manually or by direct herbicide application onto the new emerging plants. Among the most effective herbicides for the control of Prosopis are 2,4-D, dicamba, triclopyr and picloram. They should be applied carefully and avoiding drift that can affect neighbouring plantations. In areas of moderate infestation, manual removal can be well implemented combined with the stump painting with an effective herbicide. In areas of Yemen, wetting the stump with kerosene and further burning have provided effective control of the plants. It is extremely important not to leave land uncovered after clearing the affected areas. Planting new trees of an appropriate grass will help to prevent issues of soil erosion and provide competition from regenerated *Prosopis* plants. To avoid the spread of Prosopis the release of insect seed feeders, such as *Algarobius prosopis* has been found as an effective alternative in South Africa. This insect normally affects seed germination, but not growth of the plant.

(21) Invasive Alien Species in Israel - how are we doing?

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Invasive Alien Species are described as 'exotics' by some of the botanists around the globe. Unfortunately, new introductions of these "exotic" invasive species cause a major phytosanitary task for plant protection and inspection authorities. For many of the invasive weeds, control methods are difficult to accomplish, mainly because they are made after the weed is substantially established, and far beyond the ability to eradicate all contaminated areas. Some species belonging to the *Ambrosia* genus are considered invasive plants and cause damage to agriculture and environment. Several years ago it was confirmed that several none-native species of *Ambrosia* invaded Israel. Two annual species ,*A. trifida* and *A. artemisifolia*, were identified in the Northern Galilee in a migration bird (Cranes) feeding site in which corn grains imported from the USA are distributed. Among the two perennial species, *A. confertiflora* was found along river banks and roadsides in the coastal plain of the country, whereas *A. tenuifolia* was found in very limited and narrow areas. *A. confertiflora* is a very hard to kill weed, and control methods implemented a few years ago, based on post application of fluroxypyr or 2,4-D with glyphosate. However, during 2008-2009, *A. confertiflora* has spread to three other locations, more than100 km away from the initial population. So, there is a need to develop more efficient methods to control and prevent spread of these species. Future managing programs might include the implementation of the Australian model of using a bio-agent such as the stem galling moth *Epiblema strenuana*.

(22) May we expect "granivory" by isopods also in their original terrestrial biotopes of Mediterranean region?

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Isopods are the only crustaceans that have become widespread in a variety of terrestrial habitats, ranging from tropics at rain forests to desert and are very abundant in the Mediterranean region. Terrestrial isopods (Crustacea: Isopoda: Oniscidea) are generally considered detritivores, but recently was recorded also facultative granivory and seedling consumption. Terrestrial isopods may therefore contribute to the depletion of soil seed bank due to post-dispersal seed and seedling predation of weeds and volunteers. In central Europe, relative importance of seed and seedling predation in dandelion (*Taraxacum officinale*) was investigated, which is worldwide distributed model species. The abundance of the main predators (carabid beetles, molluscs and **terrestrial isopods**) was determined and differentiations in predation between two sites which differed in humidity. At the "moist" and "dry" site, on average, 28 % and 48 % of the seed did not germinate and 43 % and 35 % succumbed to predation. Ground beetles (particularly *Amara* spp.) and terrestrial isopods (*Armadillidium vulgare*) were efficient and dominant seed predators. Of the established seedlings on average 88 % and 32 % was killed at moist and dry sites, respectively, largely by slugs (*Arion lusitanicus*). In total seed mortality, seed and seedling predation killed 98 % of dispersed dandelion seed at the moist site and 87 % at the dry site. Surprisingly, there was no trend in the rate of seed consumption over the vegetative season. It is supposed that seed predation may be still more important in Mediterranean region where winter period is short. Terrestrial isopods are abundant at many Mediterranean biotopes. Their relative importance as seed and seedling predators may be still greater than in central Europe.

(23) Evaluation of PICKIT- a decision support system for rational control of *Phelibanche aegyptiaca* in tomato- results from 2009 validation experiments

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Broomrapes (*Orobanche* spp. and *Phelibanche* spp.) are chlorophyll-lacking root parasites of many dicotyledonous species, causing severe damage to vegetable and field crops worldwide. Egyptian broomrape (*P. aegyptiaca*) is common throughout Israel where it parasitizes a wide range of crops. It is a devastating pest mainly in processing tomato, endangering the future existence of this crop in the country. About 50 experiments, conducted during the last ten years, produced excellent results in *P. aegyptiaca* control in tomato, using the herbicides sulfosulfuron, imazapic and imazamox. The efficacy of *P. aegyptiaca* control is highly correlated with both the rates and timing of herbicide application. Furthermore, parasitism of *P. aegyptiaca* in tomato is strongly temperature (Degree Days) related. PICKIT, a decision support system (DSS) for *P. aegyptiaca* control in processing tomato, was developed based on risk assessment, on a growing degree days (GDD) model, and on a herbicide rate optimization model. The models were validated under field conditions using a minirhyzotron camera. The alpha version of PICKIT was evaluated in 2008 in five different field studies. Several model parameters have been adjusted in accordance with the results obtained in these experiments, improving the DSS prediction accuracy. A beta version of PICKIT was evaluated in the growing season of 2009 in commercial processing tomato fields. It was found that GDD is a robust parameter to predict broomrape parasitism. Effective control was achieved whenever herbicides were applied in the maximal rates according to the GDD model.

Poster Session 4

(24) Resistance of Palmer amaranth (*Amarnthus palmeri*) to ALS inhibitors

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Amaranthus palmeri (Palmer amaranth) is a summer weed which infests cotton fields in Israel causing severe yield and quality losses. POST application of the ALS inhibitors trifloxysulfuron (Envoke®, Syngenta) and pyrithiobac-sodium (Staple®, DuPont) control a wide range of weeds including palmer amaranth. In recent years, cotton growers in Israel reported a significant reduction in herbicide efficacy, particularly so with the control of palmer amaranth. One of these populations was tested and found resistant (R) to double the recommended application rate of the two herbicides (2X), as compared to a susceptible population (S) which never was exposed to those herbicides, and was controlled by 1/2X (when 1X is 11.25 g ai ha^{-1}). The aim of the present research was to characterize the resistance mechanism of palmer amaranth to ALS inhibitors. We found that the resistant palmer amaranth is cross resistant to other ALS inhibitors (iodosulfuron and sulfumeturon). Plants treated with malathion (an organo-phosphorous insecticide known as inhibitor of plant P450), prior to the application of ALS inhibitors, became very sensitive to trifloxysulfuron, probably due to inhibition of the detoxifying enzymes. These data indicate the possible involvement of a non-target site based resistance. Preliminary studies indicate that no fitness cost is involved in the ALS resistance in palmer amaranth. In future research we plan to elucidate the molecular bases involved in the resistant mechanism of the resistant population.

(25) Effect of soil wetting and drying cycles on metolachlor applied as s-dual-gold and as a controlled release formulation

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We developed a controlled release formulation (CRF) for metolachlor based on solubilization of the herbicide in micelles and adsorbing the mixed micelles on clay. This formulation was found to reduce metolachlor leaching through a sandy soil column and improved weed control activity in comparison to the commercial formulation (S-Dual Gold). The aim of this study was to test the effect of soil wetting and drying cycles (WDCs) on metolachlor fate applied as the commercial and as CR formulation. We tested the effect of WDCs on the release of metolachlor from Terra-Rosa soil. Surprisingly, the release from the soil subjected to WDCs was higher than its release from the untreated soil. We suggest that due to massive aggregation of the untreated soil the herbicide is physically trapped which reduces its release.
Metolachlor leaching was studied by applying the formulations to 2 cm layers of Terra-Rosa soil subjected to WDCs (0-3), irrigating the soil layers and measuring metolachlor in the leachate. Metolachlor leaching, applied as the commercial formulation, was high and increased with WDCs while its leaching from the CRF was moderate even when subject to WDCs. A bioassay with Terra-Rosa soil columns (20 cm) demonstrated similar results. Complete weed control was achieved for both formulations although leaching was increased with the increase in WDCs. Reduced leaching was obtained for the CRF in comparison with the commercial formulation even after two WDCs were applied to the soil columns. These results emphasize the advantage of the CRF over the commercial formulation even when the soil is subjected to WDCs.

(26) Thoughts on the effective and integrated control of purple nutsedge (*Cyperus rotundus*) in arid and semi-arid environments

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Purple nutsedge (*Cyperus rotundus* L.) is considered among the most serious weed problems of the world, since it has been reported to be troublesome in more countries, regions and localities than any other weed in the world, including many arid and semiarid regions. The ability to promote uniform tuber sprouting seems crucial for the effective control of purple nutsedge, while even a small percentage of surviving tubers can rapidly infect entire fields. Laboratory and field experiments were conducted in order to evaluate the effects of temperature alternation on the tuber sprouting. It was found that a shift of the daily temperature fluctuation from 0 to 12 ^{o}C accounted for the higher tuber sprouting, while in all cases the sprouting of the tubers of the deeper soil layers was significantly lower. Additionally, solarization seems potentially effective on purple nutsedge tuber sprouting, as long as it results not only to a soil temperature shift but also to a high diurnal variation. Therefore, the uniform sprouting of more that 90% of the tubers in the soil by means of solarization could greatly reduce persistence of dormant tubers and may allow a more complete control by mechanical, biological or chemical methods, thus resulting in a long-term control of this weed.

(27) Allelopathic potential of heliotrope (*Heliotropium europaeum* L.) on several crops of arid and semi-arid regions

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Allelopathy is one of the predominant forces in the development of plant communities and spatial patterns therein. Very few studies reported to date have assessed the allelopathic potential of *Heliotropium* ssp. and the phytotoxic effects on the growth of major crops growing in arid and semi-arid environments. Common heliotrope (*Heliotropium europaeum* L.) is an annual summer-growing weed (native to Mediterranean regions) of cereals, vegetables, orchards etc. The aim of the present study was to evaluate the allelopathic activity of heliotrope on the first growth of wheat, barley, maize, bean and duckweed. The plant bioassays with aqueous extracts of *H. europaeum* showed that the inflorescence extracts had the highest phytotoxic action, while the drastic inhibitory action of inflorescences extract was also true even at low concentrations (<50 $mg.ml^{-1}$). Furthermore, soil assays indicated that root exudates released into the soil have significantly reduced the root growth of bean and maize more than 30% compared to the control. The indicated allelopathic activity of *H. europaeum* could be further exploited in future studies, in order to identify and isolate the allelochemicals, as models for future herbicides or as a useful tool of integrated weed and crop management.

(28) Allelopathic potential of Greek oregano (*Origanum vulgare* ssp. *hirtum*)

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Several parts from *Origanum vulgare* ssp. *hirtum* plants were evaluated for their allelopathic potential on *Avena sativa*, *Triticum durum* and *Lemna minor* through *in vivo* and *in vitro* studies. The *in vivo* study was performed in growth chambers, using 5, 10 and 20 g of oregano tissue mixed with screened perlite as a substrate. The effects of oregano leaves and roots were evaluated by determining the shoot and root fresh and dry weight of oat and wheat. The *in vitro* experiments were performed in Petri dishes and Erlenmeyer flasks, were seeds from the three species were subjected to an increasing concentration of oregano extract. The extracts were obtained from oregano roots and shoots that were diluted with water and either shaked at room temperature or placed in water bath at 40°C for 24 h. The allelopathic potential of the oregano tissues was confirmed with bioassays using oat (*Avena sativa*), durum wheat (*Triticum durum*) and duckweed (*L. minor*) and determination of fresh weight and radicle length, respectively. The results strongly suggested the allelopathic potential of the oregano tissues, being more pronounced in the roots and moderate in the leaves and shoots. The inhibition of the L. minor suggested that the water soluble phytotoxic compounds were inhibitors of Photosystem II.

(29) Critical Period studies for weed control in beans in East Anatolia Region of Turkey

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Critical period for weed control (CPWC) is an important element of integrated weed management systems. Although CPWC has been studied in many crops, there have been needs for further studies under varying conditions such as climate, soil, and management. Dry beans are among important legume crops. CPWC in dry beans under the conditions of East Anatolia Region of Turkey was studied in 2005. *Amaranthus retroflexus*, *Chenopodium album*, *Cirsium arvense*, *Convolvulus arvensis*, and *Sideritis montana* were dominant species in the experimental field where the average weed density was 50 plants per m^2. Data were subjected to ANOVA and non-linear regression analysis. There was significant difference among treatments. CPWC was calculated using estimated Gompertz equation (Relative Yield=100 * exp[-0.90 * exp(-0.88 * Weeks after sowing)]) for weed free treatments and estimated logistic equation (Relative Yield =[(1/{exp(0.07* (Weeks after sowing -100)]+ 0.07}) + [(0.07-1)/ 0.07]]*100) for weeding treatments. CPWC started with sowing but end of period was changed due to yield loss allowed. CPWC lasted 4, 3.3, and 2.4 weeks depending on 10 %, 5 % and 2.5 % yield losses, respectively.

(30) Contribution of seed vigor on competitive ability of plum tomato with weeds

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Plum tomato frequently faces severe competition from summer weeds such as green foxtail (*Setaria viridis*) and jimsonweed (*Datura stramonium*) resulting in significant yield losses. Seed vigor would be seen as a crucial component to improve crop competitive ability against weeds and therefore part of an integrated approach to weed management systems. Greenhouse experiments were conducted comparing seeds from a commercial seed lot (High Vigour, HV) and seeds subjected (42 C, 100% R.H. for 3 days) to accelerating ageing (Low Vigour, LV). The growth characteristics (height and dry weights of leaves, stems and roots) of plants derived from HV and LV seeds were measured. Also replacement and above/below ground competion studies were conducted. Time of emergence was green foxtail (5 DAP), plum tomato HV and LV seeds (7DAP), and jimsonweed (9 DAP). Growth order was green foxtail>jimsonweed>plum tomato HV>plum tomato LV. Seed vigor of plum tomato did not influence plant height as the proportion of green foxtail and jimsonweed increased. In the replacement series experiments, green foxtail was more competitive than jimsonweed with plum tomato regardless of the vigor level. In experiments with jimsonweed, plants from LV seeds were less competitive for most growth characteristics only in the low proportion of the weed species. In experiments with green foxtail, plants from LV seeds were clearly less competitive during the whole increased proportion of the weed species. Plants from HV seeds were more competitive than those from LV seeds to jimsonweed mostly in the above and below ground type of competition. These results showed early competition ability of plum tomato was dependant on both seed vigor and individual weed species present.

(31) Studies on *Euphorbia* spp. and *Sida* spp. as new emerging weed problems in cotton in Greece

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Euphorbia spp. and *Sida* spp. have recently been identified as new weed emerging problems mainly in cotton fields. *Euphorbia* spp. has been rapidly expanding in Anthohori, Viotia and represents the most noxious weed in cotton and plum tomato fields in the area. *Sida* spp. has been reported in cotton fields in Palamas, Karditsa with no great degree of expansion so far. Studies were contacted on seed germination and emergence, soil weed seed bank estimation and growth analysis of both weeds. In field studies, the competitive ability of both weeds with cotton was measured. In addition, chemical weed control was studied. Both species are having a continuous germination and emergence during the cotton crop development, even after canopy closure. For *Euphorbia* spp. application of ethalfluralin (PPI; 1.332 g a.i./ha), fluometuron (PRE; 2.000 g a.i./ha), s-metolachlor (PRE; 1.250 g a.i./ha) gave 35, 45, 55% control respectively, compared to the untreated control. We are investigating (current field season) the efficacy of the post-emergent directed applications such as: glyphosate (1.800 g a.e./ha), glyphosate plus oxyfluorfen (1.800 + 240 g a.i./ha), glyphosate plus flumioxazin (1.800 g + 400 g a.i./ha). Results from these studies will offer an understanding of the weed species in order to develop effective control strategies.

(32) Rational chemical control of puncturevine (*Tribulus terrestris*) in groundnuts

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Groundnuts is an important cash irrigated crop in Israel. Puncturevine (*Tribulus terrestris*) is one of the most abundant troublesome weed in this crop causing severe economical damage. Several herbicides are registered for weed control in groundnuts but none effectively controls this weed. Recently, the herbicide Pulsar® (Imazamox SL 40 g a.i. l^{-1}), was registered in Israel for post emergence (POST) applications in alfalfa, pea, vetch and groundnuts. Field studies were performed during the years 2006-2009, in commercial groundnut fields in northern Israel, in order to evaluate the potential of Pulsar® to control puncturevine. Pulsar® was applied at three developmental stages of puncturevine: pre emergence (PRE), early POST (2-4 true leaves) and POST (after branches initiation). Pulsar® was applied at rates of 32 and 64 g a.i.ha^{-1} at 200 l ha^{-1} followed by moving pivot irrigation of 300 m3 ha^{-1}. Although Pulsar® is used as a selective POST applied herbicide worldwide, it was found to be selective to groundnuts when applied PRE. One treatment of PRE or early POST Pulsar® application (32 g a.i. ha^{-1}) effectively controlled puncturevine at low to moderate infestation levels (1-5 weeds m^{-2}). However, at puncturevine heavy infestations (>5 weeds m^{-2}), sequential PRE and early POST treatments of Pulsar® applied at rate of 32 g a.i. ha^{-1}, were required for effective control of the weed.

(33) Studies on the biology of common purslane (*Portulaca oleracea*)

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Common purslane (*Portulaca oleracea*) is troublesome succulent annual weed causing severe damage to irrigated field crops, vegetables and fresh herbs in Israel. The stems are reddish and the fleshy succulent leaves alternate. Flowers are small, yellow and grow in clusters. The flowers are hermaphrodite (male and female organs are on the same plant) and are pollinated by insects; the plant is self-fertile. The small, shiny-black edible seeds are wrinkled and packed in a tiny pod. The objectives of this study were to study the biology of common purslane. Specific objectives were to study the a) timing of key developmental stages in two soil types; b) effect of seed burial depth on emergence; and c) the ability of intact purslane steams to strike roots after mowing. It was found that the developmental stages of branching, flowering, seed production and ripening could be predicting by growing degree days. Under summer conditions, two weeks after flowers setup, seeds were ripe and dropped into the soil increasing the seed bank. The vigor of purslane was higher in heavy soil as compared to sandy soil. Purslane seeds can emerge only when the seeds are buried at depth of no more than1-3 cm. When purslane branches were weeded, and replanted, the plant recovered producing new root system, flowers and seeds. The results presented in this study demonstrate key factors making common purslane a hard to control weed. However, knowledge of its biology, e.g. timing of phonological stages or re-grow ability after mowing, can assist to develop strategy for a rational control system.

(34) Long term herbicidal weed management on weed flora shift in transplanted lowland rice-rice cropping system of southern peninsular India

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Field experiments with rice-rice cropping system were conducted from Kharif 2000 to Rabi 2006 to study the influence of continuous application of herbicides on change in weed flora in transplanted rice-rice ecosystems. Treatments included hand weeding, combined application of butachlor plus 2, 4-DEE for both seasons and the rotational use of butachlor plus 2.4-DEE and pretilachlor plus 2,4-DEE for Kharif and Rabi seasons respectively. Weed observations were taken at 60 days after herbicide application and the results of XIV crop was compared with the first crop. The analysis of SDR of weed species showed that the grass weed density was reduced from 53.0% in Ist crop to 31.5% in the XIV crop where farmers method of weed control was practiced with 100% nitrogen as inorganic. Whereas an increase in grass weed density was observed from 47.2 to 59.2% from I crop to XIV crop where farmer's method of weed control was practiced with integration of nutrients. Irrespective of the weed control treatments, *Echinochloa colona* and *Leptochloa chinessis* which were present in I crop where completely absent in both the stage and a shift in weed species from *E. crusgalli* to *Panicum distachyon*, was observed in the rotational use of herbicides. Increase in total sedge density was observed in all the treatments. While the broad leaved weed density was higher in hand weeding and were completely eliminated from the treatments which received chemical and rotational application of herbicides. *Ludwigia parviflora*, *Ammania baccifera* and *Marselia quadrifoliata* were the broad leaved weeds present in the XIV crop of rice.

(35) Ecobiological quantification and integrated management of *Striga asiatica* (L.) in sugarcane (*Saccharum officinarum* L.) planted in Alfisols of India

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Sugarcane (*Saccharum officinarum* L) is one of the most important cash crops and plays a pivotal role in both agricultural economy. Weed infestation is one of the most dominant constraints and *S. asiatica* remove nutrients and extract water and the effect of this parasitic weed has been so devastating, leading to complete crop failure. Hence, an experiment was conducted to quantify the biological characteristics of *S. asiatica* and its integrated management in sugarcane. Biological characters of *S. asiatica* indicated that the seeds took on an average 49 days for emergence after cane planting with mean maximum and minimum dry weight of 0.695 g and 0.530 g plant^{-1} at seedling stage (15 DAE) and recorded maximum of 1.746 g and minimum of 1.135 g plant^{-1} dry weight at active vegetative growth stage (30 DAE). Tiller production varied from 4 to 6 tillers with an average of 4.6 per plant. Flower initiation period of *S. asiatica* varied from 26 to 32 DAE. Capsule production capacity was very high with an average of 306 capsules plant^{-1} and with average dry weight of 0.304 g capsule^{-1}, with each capsule containing thousands of seeds. Results of integrated management of *S. asiatica* revealed that pre-emergence application of atrazine 1.0 kg ha^{-1} on 3rd days after planting (DAP) + hand weeding on 45 DAP + earthing up on 60 DAP combined with post-emergence spraying of 2,4-D sodium salt 5 g l^{-1} (0.5%) + urea 20 g l^{-1} (2%) on 90 DAP for effective control of *Striga asiatica* and for higher productivity and profitability in sugarcane.

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(36) Sulfonylurea herbicides' residues affect sunflower (*Helianthus annuus* L.) growth: A bioassay approach

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Sulfonylurea herbicides are among new herbicide options that are used to control broadleaved weeds and some grasses in cereal crops. However, there are many reports indicating the harmful effects of residues of these herbicides on the following crop. In order to assess the effects of residues of sulfonylurea herbicides on sunflower, a greenhouse experiment was conducted in greenhouse facilities of the Iranian Research Institute for Plant Protection. Treatments included the soils sprayed with sulfosulfuron+metsulfuron methyl at 28, 36 and 44 g ai ha^{-1}, iodosulfuron+mesosulfuron at 18, 24 and 30 g ai ha^{-1}, sulfosulfuron at 21, 31.5 and 42 g ai ha^{-1}, chlorsulfuron at 7.5, 15 and 22.5 g ai ha^{-1} and iodosulfuron+mesosulfuron+mefenpyr at 12, 18 and 24 g ai ha^{-1},and no-herbicide control. Soil was sprayed with herbicide early 2008 and sunflower was planted in mid 2008. Length and weight (dry and wet) of different plant organs (root, stem and leaf) were measured at four-leaf stage. Results showed that sulfosulfuron+metsulfuron methyl at 44 g ai ha^{-1} and iodosulfuron+mesosulfuron+mefenpyr at 24 g ai ha^{-1} had the highest negative effects on sunflower root, stem and leaf compared to other treatments. The negative effects of these herbicides were increased by an increase in herbicide application rate. Sulfosulfuron+metsulfuron methyl at the highest dose reduced sunflower root and stem length by 81.29% and 61.59%, respectively. These amounts were 73.81% and 78.53% in case of iodosulfuron+mesosulfuron+mefenpyr, respectively. Among different sunflower organs (root, stem and leaf), the roots were the most sensitive part to the residual of sulfosulfuron+metsulfuron methyl and iodosulfuron+mesosulfuron+mefenpyr. Sulfosulfuron at all doses had the lowest negative effect on sunflower. Overall, it can be concluded that sunflower is sensitive to residuals of sulfonylurea herbicides especially when they are applied at high doses.

(36B) Effective, long-term control of bindweeds and morningglories: Herbicide application on *Calystegia sepium*, *Convolvulus arvensis*, *Fallopia convolvulus*, *Ipomoea hederacea*, *Ipomoea purpurea*

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Bindweeds and morning glories are annual or perennial often herbaceous plants that have a common growth habit of climbing or smothering other plants. Some are grown for their beautiful flowers but many are problematic weeds which smother crop plants and compete for water, nutrients and light. Non-chemical control including harrowing post-seeding, mowing, deep tillage practices and preventive methods such as rotating competitive crops, intercropping and high cultivars show only limited success in controlling these weeds. Greenhouse studies were conducted under controlled conditions with five important representative species: black bindweed (*Fallopia convolvulus*), hedge bindweed (*Calystegia sepium*), ivyleaf morningglory (*Ipomoea hederacea*), tall morningglory (*Ipomoea purpurea*) and field bindweed (*Convolvulus arvensis*). This presentation will provide an insight into the biology of these troublesome weeds, indicating how the above-ground aerial parts of these plants (shoots) can be easily controlled by several herbicides but the root growth can only be controlled via systemic compounds. Recent glasshouse studies have shown that dicamba and thiencarbazone are good at controlling such plants for a long time. The application of the post emergence herbicide dicamba at 450 g a.i./ha following the application of the herbicide thiencarbazone at 45 g a.i./ha pre-emergence resulted in good weed control in most cases (above 94 %). Another experiment demonstrated that these substances are translocated from the shoots into the roots preventing the reproduction of root buds in the perennial weed *Convolvulus arvensis*. Finally field studies aimed to confirm results of greenhouse experiments will be presented.

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Parasitic weeds 5

(37) Predicting the development of the 'hidden half' in *Orobanche* spp.

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Temperature is strongly related to the dynamics of *Orobanche* and *Phelipanche* spp. parasitism on its hosts. In previous studies, we have described the relationship between temperature and the parasitism process of *P. aegyptiaca*, *O. minor,* and *O. cumana,* in tomato, red clover, and sunflower, respectively. Temperature data collected from studies conducted under controlled conditions and in the field were converted to growing degree days (GDD). Reanalysis of the data from those studies enabled us to develop a predictive model for the parasitism dynamics based on GDD for *P. aegyptiaca*, *O. minor,* and *O. cumana,* in tomato, red clover, and sunflower, respectively. *Orobanche* development was classified into stages according to the sizes: S1 - 1 to 2 mm; S2 - 3 to 4 mm; S3 - 5 to 10 mm and S4 - greater than 10 mm including shoots. The predictive models were developed independently for each host based on the temperature range that reflects climatic conditions during the crop season. The model predicts lag, log and maximum phase for the four parasitism stages in relation to GDD in all the three crops. The model was validated and confirmed in field experiments in tomato and sunflower. In future related studies, the proposed predictive models benefit us as base models that will be used to optimize chemical control of the parasite and to alter sowing dates in order to avoid or reduce parasitism rate. A decision support system PICKIT that was recently developed is based on GDD model.

(38) Transmission of plant viruses from a host plant to the parasitic weed *Phelipanche aegyptiaca*

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Orobanche aegyptiaca is an obligate holoparasite that lacks chlorophyll and is entirely dependent on a host plant for all nutrient needs. This weed represents a serious threat to commercially important vegetable and legume crops causing severe losses in yield, quality, and quantity. *Orobanche* physically connects to its hosts through haustorial structures which connect between both the parasite and the host vascular system. In this study we investigated the movement of various host viruses from infected tobacco and tomato plants to the *Orobanche* parasite. Our results demonstrate for the first time that *Orobanche* can be thus infected by the viruses; *Tobacco mosaic virus* (TMV), *Cucumber mosaic virus* (CMV), *Potato virus Y* and *Tomato yellow leaf curl virus* (TYLCV). In order to confirm CMV RNA infectious in *O. aegyptiaca* tissue, we used test plants that exhibit systemic (*Nicotiana taobacum* and *Nicotiana glutinosa*) and local lesions (*Chenopodium quinoa*) symptoms for back-inoculation. Sap-extract from *Orobanche* tissue grown on virus infected hosts was infective on test plants. We also detected accumulation of both plus and minus RNA strands of CMV and TMV in *Orobanche* stems grown on infected tomato or tobacco by RT-PCR. In addition, CMV particles and CMV-siRNAs accumulated to high level in *Orobanche* stems grown on tobacco plants. By PCR, TYLCV DNA was also detected in *Orobanche* stems grown on tomato infected with the virus. Since CMV was replicated in *Orobanche* tissues, we hypothesize that parasitic weeds such as *Orobanche* spp., like many plant species, are hosts for viruses.

(39) Allelopathic relations in the rhizosphere between broomrapes and common weeds

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Allelopathic effects caused by plants in the neighborhood are well known, in particular germination inhibition by exuded metabolites from roots or washout from leaves. Among other, rarer metabolites, the cinnamic acid family (cinnamic, p-coumaric and ferulic acids) is known as germination inhibitors. The observation that a weedy part of a heavily infested tobacco field in Germany was free of *Phelipanche ramosa*, led to the suspicion that allelopathic effects might be involved. Analyses of root exudates by HPLC with absorption spectral analysis showed the absence of the cinnamic acid family, but the presence of considerable amounts of benzoic acid in many root exudates. Systematic germination experiments using host root exudates or GR 24, and with the addition of known germination inhibitors had as a result showed that a number of broomrape species were strongly inhibited by benzoic acid (and cinnamic acid derivatives). Interestingly, weedy broomrapes were strongly inhibited by benzoic acid. Since most plants exude strigolactones as mycorrhiza branching stimulants, weeds can reduce the broomrape seed bank by suicide germination. Our results provide evidence for beneficial effects of weeds in agriculture.

(40) Host-parasite interaction reveals inter- and intraspecific variation for *Phelipanche* species

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Holoparasites are entirely dependent on their host-plants for resources in order to secure their survival and perpetuation. Orobanchaceae is a well-known family for its high host-plant specificity. This specificity is determined by the chemical signals exuded from the root radical system of host-plants which stimulate the germination of *Orobanche* seeds. However, during host-parasite interaction, a variation in behavior has been observed for both living organisms. In one case, not all host plants do they exude substances with the same chemical composition. On the other hand, broomrape seeds demonstrate different sensitivity in the biochemical stimulus derived from plant-host roots. The latter point constituted the main research objective of the present study. Several host-plants such as tomato, tobacco and rapeseed were tested in order to examine the differentiation in germinability and the number of tubercles formed by seeds of *Phelipanche ramosa* and *Ph. aegyptiaca* populations collected throughout Greece during 2002-2004. Different varieties of the aforementioned hosts were also screened. Plastic bag assays were proved very effective to study hosts and holoparasite interactions *in vivo*. All host-plants were parasitized with a variation in the number of germinated seeds and tubercles formed by *Ph. ramosa* and *Ph. aegyptiaca* species. Even host varieties demonstrated a differential response to parasitism. Tomato and tobacco were the most infested host-plants whereas rapeseed was the least parasitized. Apart from interspecific variation, a considerable amount of intraspecific variability was observed among *Phelipanche* populations for all examined hosts.

(41) *Abutilon theophrasti* a new host for *Phelipanche aegyptiaca* in Israel

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Egyptian broomrape (*Orobanche aegyptiaca*) parasitizes a broad host range of agricultural crops such as; Fabaceae (Legumes), Solanaceae (eggplant, tomato, tobacco, potato and capsicum peppers), Apiaceae (Umbellifferae - carrot, parsley, celery), Brasicaceae (Cruciferae (-oil seed rape, cabbage) lettuce and sunflower. Parasitic plants are sensitive to host germination stimulants for a short period of time only, and then enter into secondary dormancy relatively quickly. This ability ensures that these very small size seeds can respond to the germination stimulants produced by their very specific hosts will occur only during a restricted period of the year (something is missing). We found that *O. aegyptiaca* is capable to parasitize *Abutilon theophrasti*, a Malvaceae species never before mentioned as an host in literature. The ability of *O. aegyptiaca* to detect, recognize and parasitize *A. theophrasti*, presents an immediate threat that this parasitic weed could parasitize other Malvaceae species like cotton, okra and other ornamentals that belong to this botanical family. During the last two years we collected seeds of *O. aegyptiaca* and *A. theophrasti* from the field where the parasitizing first detected and checked their host-parasite relationship. Under greenhouse conditions, *A. theophrasti* plants were heavily damaged, less developed and set fewer seeds compared to non-parasitized plants, Future studies are planned to determine whether this parasitism could expand to cotton or other Malvaceae plants.

(42) Metabolites isolated from pea root exudates as stimulants for broomrape species seed germination in a differential manner

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Pea (*Pisum sativum*) crop is very severely damaged by *Orobanche crenata* infection. Although it is little infected by other broomrape species, pea root exudates stimulate the germination of other species such as *Phelypanche aegyptiaca*, *O. foetida* and *O. minor* besides *O. crenata* causing suicidal germination. Seeds of these parasitic weeds may remain dormant in the soil for many years until germination is stimulated by the release of a chemical signal by roots of a host plant. In this paper, we describe the stimulation activity of pea root exudates on germination of *P. aegyptiaca*, *O. crenata*, *O. foetida* and *O. minor*. The organic extract was purified by a silica gel column chromatography and then by TLC, yielding two compounds, named peagol and peagoldione. They induced germination of the broomrape species in a differential manner. Peagol induced *P. aegyptiaca* and *O. foetida* seed germination but low activity was observed on *O. crenata* and *O. minor*. Peagoldione induced *P. aegyptiaca* seed germination only, with no activity on *O. crenata* or *O. minor*, and very little one on *O. foetida*.

(43) Broomrape (*Orobanche crenata*) management in grain and forage legumes

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Legume cultivation is strongly hampered in Mediterranean and Middle East farming systems by the occurrence of *Orobanche crenata* Forsk. A number of strategies of root parasitic weed control have been developed including cultural practices and chemical control. Though limited in efficacy in many cases, the control methods available today represent a major progress when compared to the lack of any means for the control of these plants one or two decades ago. Integrated broomrape management programmes will be discussed in the light of recent basic research successes in plant-pathogen interaction together with modern breeding strategies. The new findings in molecular biology and physiology of parasitism will help in developing new integrated and effective control strategies. Each technology should be integrated with others synergistically to affect control, which will be more resilient while reducing weed seed banks, so that unlike the current situation, susceptible crops can be part of a rotation.

(44) Herbicide resistant weeds and crops: a north American perspective

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The history of herbicide resistance (HR) in North America differs greatly from the European experience. While herbicide resistance has been common on both continents, the widespread adoption of glyphosate tolerant crops and their subsequent use has resulted in an increased selection pressure for those plants that could survive a postemergent glyphosate application. Currently, the greatest challenges to agronomic weed control in the United States are those weeds previously controlled by glyphosate but are no longer controlled. The major agronomic examples of these weeds include *Conyza canadensis*, a winter annual that is problematic in no-tillage production systems, and *Amaranthus palmeri*, a tremendously competitive summer annual that is a growing problem in the southern United States. Both of these weedy species are primarily occurring in the southern portion of the United States. Somewhat surprisingly, most farmers in the large crop-producing regions of the midwestern United States (the so-called corn-soybean belt) are not experiencing glyphosate control failures, although some sporadic instances of glyphosate failures are occurring on species from the *Ambrosia*, *Conyza*, and *Amaranthus* genera (as well as others). Major differences between the respective areas of the United States will be contrasted. Specific case histories to illustrate ecological principles and the effect of HR on water use efficiencies will be focal points of this presentation.

Herbicide resistant weeds and crops and risk assessment

6

(45) Herbicide resistant weeds in the Mediterranean dry land farming

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The evolution of herbicide-resistant weeds in dry land farming endangers the profitability of arable crops in various Mediterranean countries. Chemical weed control in non-irrigated arable crops is necessary due to the strong competition employed by winter broadleaved and grass weeds. The relatively small number of crops available imposes the farmers to grow cereal as monoculture interrupted with fallow years, minimize soil tillage and the use of the same or chemically-similar herbicides. This selection pressure resulted in the evolution of a large numbers of herbicide-resistant weeds. The cost of chemical weed control often drives the farmers to apply herbicides at low rates facilitating the evolution of non-target site resistance. An altered target site resistance to ALS-inhibiting herbicides was identified in numerous weed species infesting arable crops. At least three different point mutations were identified in the ALS gene in these weeds. Similarly, post-emergence applied ACCase inhibiting herbicides against grass weeds resulted in an altered target site resistance in important weeds such as *Lolium rigidum*, *Phalaris minor*, *P. paradoxa* and *Avena sterilis*. These resistant grass weeds conferred various alterations of the target enzyme endowing different resistance response to these herbicides. Glyphosate-resistant *Conyza bonariensis* and *C. canadensis* populations is a most dangerous phenomenon which endangers the adoption of minimum tillage practices and may also pose a threat to irrigated crops due to the easy seed dissemination by wind. The need for integrated weed management is now crucial.

(46) Characters for the in situ recognition of some *Conyza* species and glyphosate resistant populations from Greece

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Conyza species have become noxious weeds in several parts of the world, including Greece,. Their vigorous growth, enormous seed set, elasticity of life-cycle and herbicide resistance made them persistent weed problems in vineyards, orchards, vegetables and several other crops. In southern Greece, *Conyza* spp. are considered noxious weeds, mainly in perennial crops. Complaints from Greek farmers about glyphosate reduced efficacy against *Conyza* species are significantly increasing every year. The objectives of this preliminary research were to evaluate the overall situation concerning glyphosate resistance in *Conyza* spp. biotypes in southern Greece in glasshouse trials and to suggest alternative herbicides or other solutions to control effectively these species. Moreover, for the safe *in situ* recognition of the several *Conyza* species, a set of selected morphological characters is proposed. Plant height, length of secondary stems, shape of leaves and inflorescences and leaf colour could significantly help. Thirty five Greek populations of *Conyza* species, sampled from several locations, were studied under controlled conditions to confirm glyphosate resistance. In the initial screening, under controlled conditions, significant differences in glyphosate response between populations were observed. From the initial screening, thirteen populations were selected, and a dose–response experiment was conducted. For the effective (>90%) control of the most resistant populations, originating from Lakonia and Argolida prefectures, the required dose was 4-5 times higher than the recommended one. Therefore, further trials have been conducted in order to find alternative solutions to this problem

(47) Glyphosate resistance in *Conyza* spp. is dependent on environmental conditions

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Conyza bonariensis and *C. canadensis* are problematic weeds in roadsides, orchards and cultivated fields, mainly when reduced tillage is practiced and chemical weed control relies on knock-down herbicide application. A survey conducted in Israel has shown that several populations of *C. bonariensis* and *C. canadensis* are glyphosate resistant (GR). Studies have shown that plants become more resistant with increasing the temperature from 16°C to 34°C and with plant age from 15 to 100 days after planting (DAP). Shading of plants for 3 d before glyphosate application significantly increased their sensitivity to the herbicide. Comparative studies conducted with GR and glyphosate sensitive (GS) *C. bonariensis* have shown that the level of resistance (RI = ED50R/ED50S) vary from 3.6 to 36 depends on the selection parameter. No differences between GR and GS were detected in shikimate accumulation in leaf discs exposed to glyphosate for 18 h in light. However, when GR and GS plants were treated post emergence with glyphosate (0.18 kg ae/ha), the GS plants accumulated 1.6 to 3.7 folds more shikimate then the GR plants within 24 h. Using ^{14}C-glyphosate we found that GS and GR plants absorbed similar amounts of ^{14}C in source leaves, but GS plants translocated more glyphosate to untreated leaves, apex and roots as compared to GR plants. These results indicate that the GR and GS biotypes of *C. bonariensis* differ in glyphosate translocation from site of uptake to the site of action in the chloroplasts.

(48) Bio-efficacy evaluation of glyphosate on herbicide resistant corn hybrids (event NK 603) for crop safety and weed control efficiency

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Glyphosate resistance is the dominant transgenic trait, cultivated in 114 mha across 23 countries. As an initiative on transgenic crop, glyphosate resistant event (NK 603) corn hybrids evolved by Monsanto India (Pvt.) Ltd., were evaluated during w*inter* 2008-09 at experimental site of Tamil Nadu Agricultural University; Coimbatore. Glyphosate was applied as early POE application at 900, 1800 and 3600 g ae/ha in Hishell and 900 M Gold transgenic corn hybrids compared with non transgenic counterparts with PE atrazine at 0.5 kg/ha + HW on 40 DAS. Broad leaved weeds constituted 88%, grasses 9% and sedges 3% before POE herbicide spraying. Early POE application of glyphosate at 900, 1800 and 3600 g ae/ha registered lower weed density in transgenic Hishell and 900 M Gold corn hybrids and was on par with PE atrazine at 0.5 kg/ha +HW on 40 DAS in non-transgenic hybrids. Glyphosate at all doses, recorded significantly lesser weed dry weight and higher weed control efficiency with no crop phytotoxicity in transgenic corn. Complete drying of all the weeds was observed at 10 DAHS except *Commelina benghalensis, Portulaca oleraceae* , *Amaranthus polygamous* and *Cyperus rotundus* that developed chlorotic and drying symptoms at 20 DAHS with 1800 and 3600 g ae/ha. Higher grain and stover yields were recorded with POE application of glyphosate at 900, 1800 and 3600 g/ha in Hishell and 900 M Gold transgenic corn hybrids with average yield of 10 t/ha and 8 t/ha in conventional corn hybrids.

(49) Effect of increasing doses of glyphosate on water use efficiency and photosynthesis in glyphosate-resistant soybeans

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The global increase in cultivated area of glyphosate-resistant (GR) soybeans has raised questions regarding secondary effects of glyphosate on physiology of GR soybeans. In this work, we attempted to evaluate the effect of increasing doses of glyphosate on water absorption and photosynthetic parameters of GR soybean. Plants were grown in a complete nutrient solution and subjected to a range of doses of glyphosate either as single applications at V4 or sequentially at V4 and V7 stages. Net photosynthesis, transpiration rate, stomatal conductance, sub-stomatal CO2, carboxilation efficiency, fluorescence, maximal fluorescence and chlorophyll contents were monitored right before and at different stages after herbicide application. Water absorption was measured daily; biomass yield and water use efficiency were estimated by harvesting plants at the R1 stage. All photosynthetic parameters were affected by increasing glyphosate doses. Chlorophyll contents were reduced right after glyphosate use, however decreased chlorophyll content and carboxilation efficiency suggest that glyphosate may have interfered in the synthesis of chlorophyll and/or in carboxilative metabolism of photosynthesis. Total amount of water absorbed and biomass production by plants were also decreased as glyphosate doses increased, with a more intense effect of single application, as compared to sequential. WUE was significantly reduced with increasing glyphosate doses.

(50) Potential of Roundup Ready system for control of main weeds in maize in Central Europe

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GM Roundup Ready (RR) maize with herbicide tolerance might be introduced in EU soon. RR system disposes of many advantages for users, especially by wide spectrum of efficacy and high level of selectivity. Like in other herbicides, there are some weaknesses resulting from zero residual activity and differences in sensitivity in individual weed species. To adjust the usage of RR system for our conditions, small plot field trials were carried out in maize in 2007-2009. Treatment list comprised conventional pre- and post-emergence herbicides, the RR herbicide applied solo at the hectare rates of glyphosate 720, 1440, and 2880, the split application of 1080 g twice, and the combination of 1080 g glyphosate with 2100 g acetochlor to ensure residual activity. Recommended RR treatments showed comparable effect with conventional post-emergence herbicides and better effect than pre-emergence herbicides whose efficacy strongly varied in years. *Amaranthus retroflexus* and *Solanum physalifolium* were controlled well by all herbicides, including the lowest doses of RR. More difficult to control were *Chenopodium album* and *Echinochloa crus-galli* where the split application or combination with acetochlor was necessary to reach acceptable control effect. Comparing these treatments, the results varied across years but split application of glyphosate gave better effect in average. Substantially better effect of RR, especially in split application, was found for *Mercurialis annua* which was most difficult to control from annuals. Unfortunately, neither high doses of glyphosate nor conventional herbicides were able to control the *Convolvulus arvensis* because of its strong regeneration ability. Flexibility of RR system in dosage and timing is its important feature for sustainable weed control. According the tolerance and/or germination cycles of individual weed species, the solo-, split applications of glyphosate or combinations with other herbicides can be outlined.

(51) The need for weed risk assessment

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Invasive plant species affect human health, agricultural and other systems, and their impacts are second only to habitat destruction in terms of loss of biodiversity. The most cost-effective means to manage weeds is to prevent their arrival. To this end, the procedure of weed risk-assessment (WRA) is used for identifying the weeds that may qualify as a quarantine pest in a defined area and secondly, determining the likelihood of its entry, establishment, spread, and economic importance of its impacts. This may include species already growing in a country that have not yet been classified as pests. Post-border weed risk management (WRM) is a separate exercise, which consists of various distinct stages to identify existing major exotic weeds in the country/territory, to evaluate their risk and damage, the feasibility for management actions (e.g., preventing entry, eradication, containment, research) of priorities weeds. Post-border WRM can provide a decision framework for regulatory management of weeds within countries, e.g., legal restrictions on sale and movement of declared/noxious weeds and legal requirements for their control, and selecting species priorities for research into improved control techniques and species targets for eradication.

(52) Weed risk assessment exercises in Turkey

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Turkey has very rich flora with over 10 000 plant species or lower taxa, which one third is endemics. Although flora of Turkey, at least partly, was analyzed for some botanical reasons; no Weed risk assessment (WRA) has been conducted. WRA has been getting a prominent issue in agriculture and environment. There are several methods for WRA. Actually, countries or organizations have established their own systems. FAO also developed WRA procedures. The aim of the paper is to present results of WRA of some naturalized species in the Eastern Black Sea Region. Thirty-two naturalized taxa underwent WRA using FAO system. Different scores were obtained. For example, *Sciyos angulatus* hit 7, *Conyza bonariensis* and *Conyza Canadensis* gave 6, and *Commelina communis*, *Lepidium virginicum*, *Albizia julibrissin*, and *Acer negundo* was 5. In the scoring system the question "other members of the genus are weeds" was changed as "other members of the genus are weeds or invasive in elsewhere". The main problem of WRA was that lack of information about biology and distribution of plants.

Cultural, physical and site-specific weed practices

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(53) Site specific weed management: mapping the tempo-spatial development of purple nutsedge (*Cyperus rotundus*)

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Precision agriculture is a key component of the sustainable agriculture approach. The motivation for adopting this concept includes three main factors: a) protecting the environment; b) reducing the use of pesticides and fertilizers, and c) reducing farming expenditure. Site specific weed management is aimed to identify weedy patches, weed species within the patch, and spray the appropriate herbicides according to the spatial distribution of the weeds within the field. A new approach is suggested, which includes combining information extracted from several sub-models into both image processing algorithms and a geographical information system (GIS) database. This information consists of the expected weed density (number of plants per m^2 or number of leaves per plant), and of the predicted spatial development of the weed. The current abstract describes various means for the detection of purple nutsedge (*Cyperus rotundus*), and its integration in a site specific weed management program. Purple nutsedge is a noxious weed causing heavy damage in irrigated summer crops. Its ability to reproduce by forming underground tubers and bulbs provides it with a unique competitive advantage over many crops. A multiple approach is required for the detection of its spatial development, because it should include detection technologies for both above and below ground. Our approach thus includes: a) spectral analysis of purple nutsedge obtained from satellites; b) leaf shape analysis obtained from image data, c) photogrammetric (3D) analysis obtained from image data and laser (LIDAR); d) modeling spatial sprouting of the weed under different environmental conditions; and e) modeling the soil-subsurface development and its reflectance on purple nutsedge spatial sprouting. In conclusion, integration of the biological and technological means for purple nutsedge detection support and complements each other, and may provide a new dimensions in its precision management.

(54) The use of flex-tine harrow, torsion weeder and finger weeder in saffron (*Crocus sativus* L.)

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The use of mechanical weed control devices designed in Northern Europe need to be adapted to Mediterranean conditions to achieve high efficacy. The problems found in saffron are discussed in this communication. Saffron is grown usually in the Spanish cold drylands and need weed control after harvesting the flowers in late October until summer, afterwards few weeds grow due to drought. Weed control during winter needs to respect the leaves which develop after flowering and die in May. The corms with the new flower buds develop in March and soil should not be disturbed during that period. Afterwards tillage can be conducted overall without respecting the crop, which remains buried at 20 cm depth. One problem found in this crop is the presence of tap-rooted weeds like *Descurainia sophia,* fibrous rooted dicots like *Lamium amplexicaule* or grass weeds like *Lolium rigidum* which needs to be controlled very early with mechanical methods. As the plantation of the corms is conducted in rows at 20 cm distance, the devices need to be fitted at small distance and accurate steering is needed with torsion and finger weeder. In early spring, the flex-tine harrow offers good possibilities as aggressive positions can be used due to the depth of the corms. Two passes, one in winter and one beginning of spring will normally be necessary. Weed harrowing is probably the best solution for weed control, provided that the weeds are small enough. Precision tools are difficult to use as weeds will be too big due to rainfall in autumn and winter and because of irregular planting.

(55) Definition of the optimal resolution required for remote sensing of purple nutsedge (*Cyperus rotundus*) in cotton

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Purple nutsedge (*Cyperus rotundus*) is a troublesome weed causing heavy damages in irrigated crops including cotton. Precision farming is an agricultural concept relaying on the existence approach of within field variability. More specifically, site specific weed management aimes to detect weeds and control them by management zone. The main goal of the current research program was to define the optimal resolution required for a robust detection of purple nutsedge in cotton. The research was conducted in a commercial cotton field characterized with spatial variation of purple nutsedge. In spring 2008 the field was photographed by an aerial camera in red, green and blue (RGB) channels, with a high resolution of $25cm^2$ (5 cm by 5 cm) per pixel. At the same time, estimation of purple nutsedge infestation was done in 25 plots that were randomly chosen. Eight random locations extracted from the field photograph for data analysis. Out of several possible vegetal indexes, NGRDI index was selected to calculate the level of greenness from the digital data. We hypothesize that weed could be detected when NGRDI index is significantly higher than soil index. In order to reduce the resolution and causing the image to be less detailed several nearby pixels were combined by performing averages of the color values in different channels. This procedure was repeated starting from the maximal resolution where the image is most detailed to the level in which no significant index between weeds and soil were observed. It was found that when pixel size was 2500 cm2 (50cm x 50 cm) or smaller, purple nutsedge patch could be detected. This resolution can be captured today by tractors or airplane but not from satellite.

(56) Spatial and multi-temporal weed mapping at early stage of cotton crop using GIS.

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The prefecture of Karditsa in Greece is in the center of the main cotton zone of the country. Cotton is a traditional crop in this region, and it is cultivated there for many decades. Weed control was always and is still being one of the most important practices. In this particular region weed control always consisted of chemical control in combination with cultivation techniques. In the past high yield losses were recorded due to insufficient weed control. The scope of this study was to determine the type and distribution of weeds in cotton zones of this particular area. The sampling took place during the cultivation periods 2007-08 and 2008-09. The soil properties (from soil maps), the weed species and the irrigation method were recorded for each sampling site. Furthermore climatic data were available in order to observe possible differences between these two seasons. Finaly, the location (coordinates) of each sampling site was recorded using a GPS device. There were found numerous annuals and perennials weed species, with the latter proving their persistence in the cotton fields. *Cyperus rotundus* and *Convolvulus arvensis* were the most common weeds. We also found that the weed populations in cotton fields irrigated by sprinklers were significantly greater than those that were irrigated by drippers. As a result, weed maps were created (using Inverse Distance Weighting method) showing the distribution of weeds using a GIS software. Comparing the distribution and the appearance of the above two most common weeds we observed that similar results were obtained for both cultivation periods.

(57) An integrated physical approach to control purple nutsedge (*Cyperus rotundus*)

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Purple nutsedge (*Cyperus rotundus* L.) is considered to be one of the world's worst weeds, especially in the tropical and subtropical regions. In Israel, where purple nutsedge is also regarded as an important weed, seeds only rarely germinate and reproduction is vegetative by underground tubers. The rapid growth, prolific propagation through a complex underground system of rhizomes and tubers and its narrow leaves with thick cuticles makes it extremely difficult to control by mechanical or chemical means. The weed affects mostly summer irrigated vegetables causing high yield losses. In order to control the weed we integrated mechanical removal of the tubers and plastic mulching. In pot experiment purple nutsedge tubers were buried in depths of 0, 10, 20 and 30 cm and the pots were covered with 200 μm thick black nylon. The tuber sprouting was monitored for several months. Various plastic mulching thicknesses were tested for their ability to prevent purple nutsedge penetration in pots as well as in the field. In field experiments, mechanical removal of the tubers was preformed. The mechanical tuber extraction from a depth of 30 cm resulted in a soil layer of 10 cm containing 99% of the tubers. The time for complete tuber desiccation and death was found to be two weeks. Finally we integrated the two methods together - tuber extraction and plastic mulching. The results will be discussed.

(58) EcoPest: Sustainable use of herbicides in a pilot area in Kopaida, Greece

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EcoPest (www.ecopest.gr) is a pilot-scale demonstration project (2009-2011) aiming to develop, apply and demonstrate an economically viable Strategic Plan for the sustainable use of herbicides via its minimization and the effective management of the related risks in line with all the latest EU policy reforms. This project is focusing on: 1. Development and implementation of a Low Input Crop Management system in 900 ha (cotton, maize and plum tomatoes); 2. Assessment the herbicides impact on a vulnerable inland water ecosystem, through appropriate risk indicators and targeted environmental monitoring; 3. Development of a National Certification Scheme for spraying equipment and professional users of herbicides; 4. Implementation of a strategy for herbicide substitution; 5. Spray drift management; and 6. Disposal of herbicide containers. The current presentation is related only to development and implementation of the Low Input Crop Management system. The list with the 10 most common weeds is as follows, in descending order: *Solanum nigrum*, *Amaranthus* spp, *Chenopodium album*, *Convolvolus arvensis*, *Cynodon dactylon*, *Echinochloa crus galli*, *Datura stramonium*, *Xanthium strumarium*, *Abutilon theophrasti*, *Setaria* spp. Most noxious weed mainly for cotton is purple nutsedge (*Cyperus rotundus*) that has expanded to most fields (occurrence greater than 90% in cotton fields) with coverage ranging from 10-60% in individual fields. Minimization of herbicide use will be achieved through integration of weed mapping data together with band-application of all pre-emergent herbicides, mechanical cultivation in-between rows, and application of selective spot spray system (WeedSeeker technology). Preliminary field testing (in 15 ha cotton, 2009) has shown 60% savings in pre-emergent herbicide (fluometuron) through band-application, and 40-80% savings (depending on weed coverage) on post-emergent directed applications (glyphosate) using the WeedSeeker technology. Development and implementation of the Low Input Crop Management system at the full scale of 900ha during the next two growing seasons will test the principles of newly established EU directive on sustainable use of pesticides.

(59) Tolerance of selected weeds species to broadcast flaming.

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Organic producers rank weeds as the most important pests that limit their crop production. In order to optimize propane use as a weed control tool, the objective of this study was to collect a baseline data on weed tolerance to broadcast flaming. Field studies were conducted in 2007 utilizing six rates of propane and ten major weed species in northeast Nebraska, including: Venice mallow (*Hibiscus trionum*), waterhemp (*Amaranthus rudis*), field bindweed (*Convolvulus arvensis*), kochia (*Kochia scoparia*), Ivyleaf morning-glory (*Ipomoea hederacea*), velvetleaf (*Abutilon theophrasti*), redroot pigweed (*Amaranthus retroflexus*), barnyardgrass (*Echinocloa crus-galli*), green foxtail (*Setaria viridis*) and yellow foxtail (*S. glauca*). The propane rates included: 0, 12.1, 30.9, 49.7, 68.5 and 87.22 kg/ha (0, 2.5, 6.5, 10.5, 14.4 and 18.4 gal/a). Flaming treatments were applied utilizing an ATV mounted flamer moving at a constant speed of 6.5 km/hour (4 MPH). Species response to propane rates were described by log-logistic models based on relative dry matter for each weed species. Overall response to flame varied among the species, growth stages and propane rate. Broadleaf weeds were more susceptible to flames than grasses. Propane rate of 50-70 kg/ha provided 90% control of most broadleaf species. Although, 70-90 kg/ha provided 80% control of grasses, none of the propane rates provided 90% control. Flaming has a potential to be used effectively in organic agriculture.

(60) Efficiency evaluation of manually operated weeders for integrated weed management in irrigated corn (*Zea mays*)

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Corn is a wide spaced crop with slow early growth, allows the weed to compete easily compared to other cereals. Hand weeding effectively minimized the weed competition which consumes 15% of human labour used for corn cultivation. To substitute manual weeding, more efficient and less energy intensive manually operated weeders have been introduced. Hence, the study on efficiency evaluation of manually operated weeder in irrigated corn has been initiated with the objective to evaluate the performance of different weeders on growth, productivity and economics of irrigated corn. *Dactyloctenium aegyptium, Chloris barbata, Panicum repens*, *Cyperus rotundus Trianthema portulacasturm, Parthenium hysterophorus* and *Digera arvensis* were dominant weeds. Weeding on 25 and 45 DAS with four weeders viz., crescent hoe, multiweeder, wheel hoe and rotary peg weeder and PE atrazine 0.5 kg/ha on 3 DAS+ weeding with weeders on 45 DAS were compared with PE atrazine 0.5 kg/ha on 3 DAS + HW on 45 DAS and HW on 25 and 45 DAS. Observations on weeds and crop productivity and economics of corn cultivation were studied. Results revealed that total weed density was lower in hand weeding twice and PE atrazine 0.5 kg/ha +wheel hoe weeding. Plant height was higher in PE atrazine 0.5 kg/ha with hand weeding and wheel hoe weeding. Higher field efficiency with less man-days required for weeding was recorded in PE atrazine 0.5kg/ha +wheel hoe weeding. PE atrazine 0.5 kg/ha on 3 DAS + wheel hoe weeding on 45 DAS for higher yield and economic returns in irrigated corn.

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