

Chios
 Germination and early growth
 Weeds and invasive plants
 Weed mapping

2017

THE 5th INTERNATIONAL
SYMPOSIUM
 WEEDS & INVASIVE PLANTS
PROCEEDINGS

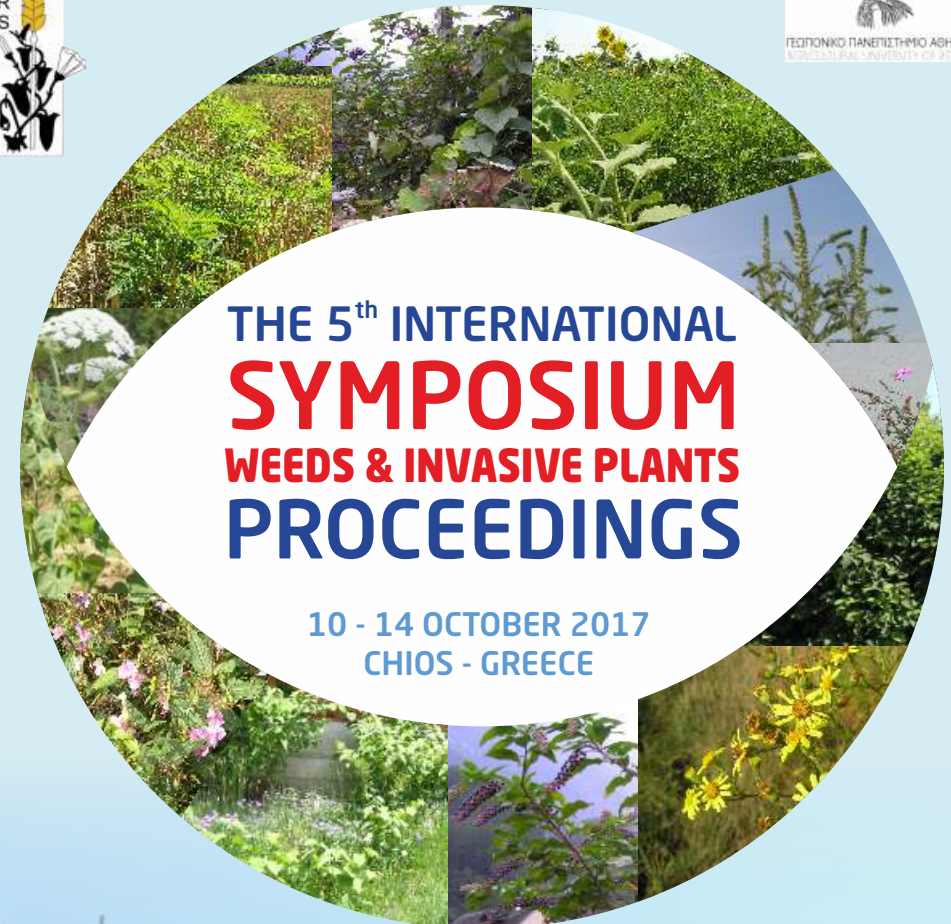
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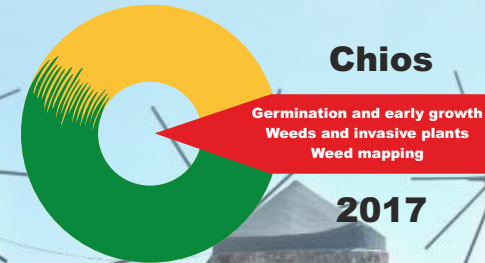
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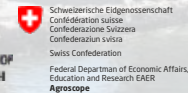
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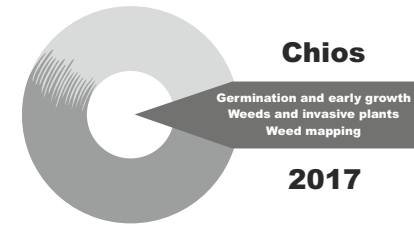
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Editors

Ahmet ULUDAG, Garyfalia ECONOMOU, Christian BOHREN, Kirsten TORRESEN, Khawar JABRAN

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SYMPOSIUM PROGRAM

	10 October	11 October	12 October	13 October	14 October
				Field trip and social day including mastic museum visit	
9:00		Registration	Registration		Registration
9:30		Keynote 2 MULLER SCHAERER	Keynote 3 KRAEHMER		Young scientists meeting
10:00		Coffee break	Coffee break		Coffee break
10:30		Session 2 Invasive alien plants and ecological aspects	Session 4 Mapping of weeds in agricultural fields		Keynote 4 GIANNOPOLITIS
11:00	Registration	Session 3 Mapping weeds in agricultural fields	Session 5 Management of invasive alien plants and weeds		Session 7 Invasive alien plants
11:30					Closing Ceremony
12:00					
12:30	Lunch	Lunch	Lunch		
13:00					
13:30					
14:00	Registration	Poster viewing	Poster viewing		
14:30	Opening ceremony				
15:00		Coffee break	Coffee break		
15:30	Keynote 1 ADKINS	WG meetings	Roundtable by Garyfalia Economou		
16:00	Coffee break				
16:30	Session 1 Weed seeds, germination and early growth		Session 6 Invasive alien plants and climate change		
17:00					
17:30					
18:00	Welcome Cocktail				
18:30			Conference dinner		

Keynote Lectures

KL 1. Steve Adkins

The global threat from biological invasions: the reproductive and physiological fitness of the invasive weed *Parthenium hysterophorus* L. under a changing climate

KL 2. Heinz Mueller-Schaerer

Predicting potential benefits and risks of biological control of common ragweed in Europe: from ecological to evolutionary studies

KL 3. Hansjoerg Kraehmer

Theoretical aspects and practical applications of weed mapping

KL 4. C.N. Giannopolitis

Current status as agricultural weeds of selected alien species arrived in Greece at a wide span of years

Oral Presentations

	Title	Presenter	Country
SESSION 1	Weed seeds, germination and early growth <i>Chaired by Kirsten Torresen</i>		
	Germination and growth characteristics of wild oats	Ahmet Uludağ	Turkey
	Effect of soil disturbance on seedling emergence of <i>Avena ludoviciana</i>	Alireza Taab	Iran
	Emergence of <i>Echinochloa crus-galli</i> populations through a climatic gradient	Aritz Royo-Esnal	Spain
	A growth model for <i>Lolium rigidum</i> with and without fertilization and crop competition	Aritz Royo-Esnal	Spain
	The effect of burial depths on seasonal germination of different weedy rice biotypes	Husrev Mennan	Turkey
	Long-term fertilization and crop rotation effects on weed seedbanks	Markola Saulić	Serbia
SESSION 2	Invasive alien plants and ecological aspects <i>Chaired by Sava Vrbnicanin</i>		
	Invasive weeds in agriculture	Christian Bohren	Switzerland
	Ecological impact of <i>Helianthus tuberosus</i> at home and away	Rita Filep	Hungary
	Applying invasibility theories to design cover crop mixes for weed suppression	Chloe MacLaren	UK
	<i>Amaranthus palmeri</i> in NE of Spain. A pioneer process of invasion?	Jordi Recasens	Spain
SESSION 3	Mapping weeds in agricultural fields <i>Chaired by Alireza Taab</i>		
	A weed survey in rapeseed fields in west of Iran	Alireza Taab	Iran
	Mapping wild oats in wheat fields in Turkey	Süleyman Türkseven	Turkey
	Spatial occurrence of weeds in sunflower fields of Evros region	P. Vahamidis	Greece
	Characterization of herbicide resistant wild oats populations from wheat fields in Turkey	Ahmet Uludağ	Turkey

	Title	Presenter	Country
SESSION 4	Mapping of weeds in agricultural fields <i>Chaired by Garyfalia Economou</i>		
	Occurrence of <i>Amaranthus palmeri</i> in citrus plantations in Adana, Osmaniye and Hatay provinces of Turkey	M. Nedim Doğan	Turkey
	<i>Ipomoea hederacea</i> (L.) Jacq. in Greece: Biology, control and current status of infestation	Vaya Kati	Greece
	Distribution of Horseweed Species in Citrus Orchards and Vineyards in Mediterranean and Aegean Region of Turkey	A. Tansel Serim	Turkey
	Native and established plant species newly occurring on arable land in the Czech Republic	Josef Holec	Czech Republic
SESSION 5	Management of invasive alien plants and weeds <i>Chaired by Ahmet Uludag</i>		
	Biology and Management of <i>Parthenium (Parthenium hysterophorus L.)</i>	Saravanane P	India
	Biology, impact, and management of serious invasive weed, <i>Sonchus oleraceus L.</i> in Australia	Steve Adkins	Australia
	Weeds and Their Control in Lady Palm Nurseries	Deniz İnci	Turkey
	Involving gardeners to identify potentially invasive plants	Katharina Dehnen-Schmutz	UK
SESSION 6	Invasive alien plants and climate change <i>Chaired by Heinz Mueller-Schaerer</i>		
	Rapid evolution of a plant invader in response to global warming	Yan Sun	Germany
	Soil moisture and temperature during reproductive growth controls seed dormancy in <i>Alopecurus myosuroides</i> Huds.	Alexander Menegat	Sweden
	Temperature influences <i>Ambrosia artemisiifolia</i> development and pollen allergenicity	Sandra Citterio	Italy
	Invasion potential of <i>Ambrosia artemisiifolia</i> in Scandinavia under consideration of current and future climate	Alexander Menegat	Sweden
SESSION 7	Invasive alien plants <i>Chaired by Christian Bohren</i>		
	Response of three-lobed morning glory (<i>Ipomoea triloba</i> L.) to some soil residual herbicides	A. Tansel Serim	Turkey
	Vegetative performance of <i>Ambrosia trifida</i> L. in competition with <i>Ambrosia artemisiifolia</i> L.	Alexandra M Savic	Serbia
	Intrapopulation variation in <i>Ambrosia artemisiifolia</i> L. seed germination	Valentina Šoštarić	Croatia
	Germination and early growth of <i>Raphanus sativus</i> and <i>Echinochloa crus-galli</i> in the presence of water extracts of <i>Chenopodium album</i> L.	Agnieszka Synowiec	Poland

Poster Presentations

No	Presenter	Title
1	Kostas Karakitsos	The current situation of invasive plants in Greece
2	Ozen Soner Fatih	Some important invasive alien species in agricultural areas in the Aegean Region
3	Zambak Sadiye	A study on common ragweed biology in the Duzce Province of Turkey
4	Holec Josef	Occurrence of weed beet (<i>Beta vulgaris</i>) and velvetleaf (<i>Abutilon theophrasti</i>) in sugar beet stands in the Czech Republic
5	Ahmet Uludağ	Determination of bio-herbicidal potential of aqueous extract of English Ivy (<i>Hedera helix</i>) on seed germination of important weed species
6	Ollivier M	Food web study, a community approach for biological control of the weed <i>Sonchus oleraceus</i> L. (Asteraceae)
7	A. Assariotakis	Spatial distribution of <i>Oxalis pes-caprae</i> L. and its effect on flora diversity of olive groves in Crete
8	Gidea Mihai	The automatic mapping of the weeded zones in the wheat crop
9	Zahra Mahmoodi Atabaki	Evaluating the efficacy of 2,4-D+MCPA, sulfosulfuron, and lintur herbicides for controlling the invasive <i>Geranium dissectum</i>
10	Kirsten Torresen	Joint experiment by the EWRS Working Group Germination and Early Growth: Emergence and phenological development of <i>Avena fatua</i>
11	Duygu Şişek	The effect of <i>Nerium oleander</i> extracts obtained by liquid nitrogen on germination and seedling development of <i>Avena</i> seeds
12	P. Vahamidis	The effect of cultivar competitiveness and soil water availability on weed species composition in malt barley
13	Ahmet Uludağ	Effects of <i>Ailanthus altissima</i> (Mill.) Swingle extracts on germination of some weed and vegetable species
14	Ahmet Tansel Serim	Determination of weed species in sunflower (<i>Helianthus annuus</i> L.) fields in Ankara, Turkey
15	E. Kaya Altop	Determination of morphological diversity of resistant and susceptible populations of <i>Anthemis arvensis</i> L. and <i>Matricaria chamomilla</i> L. to acetolactate synthase inhibitor herbicides
16	Samardzic Natasa	Allelopathic effect of <i>Cannabis sativa</i> L. extracts on <i>Ambrosia artemisiifolia</i> L. seed germination
17	Bouchikh Yamina	Allelopathic effect of two alien and invasive <i>Chenopodiaceae</i> species on germination and growth of local plants.
18	Vincent Lesieur	<i>Sonchus oleraceus</i> natural enemy community update and biological control perspectives
19	Nurcan Büyükkurt	<i>Galium aparine</i> germination under different temperatures

Preface / Welcome Message

Welcome to the weed scientists, in the beautiful and hospitable island of Chios, in the North Aegean Region.

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 the three important sectors for weed science; “Germination and Early Growth”, “Weeds and Invasive Plants” and “Weed Mapping”.

The idea of the joint meeting was not a temporal approach but the result of a matured thought on behalf of the three working groups for interactive process. Actually, the aims and the tasks of the two WGs in addition to their parallel scientific paths often meet, interact positively and generate ideas and solutions for an effective weed control with environmental point of view.

On this account, we decided to share ideas around the current status of climatic changes on the weed and particularly on invasive plants distribution 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 keynote addresses, oral presentations, a round table, poster presentations, a field excursion to meet with the good practice in improving the weed and invasive alien plants management and environmental performance in the citrus orchards, masticha crop (a unique product all over the world), as well special social activities. Enjoy your participation in the conference and your stay in the hospitable Chios.

The Organizers

Keynote Lecture 1

The global threat from biological invasions: The reproductive and physiological fitness of the invasive weed *Parthenium hysterophorus* L. under a changing climate

Steve Adkins^{1,2,*}, Ali Ahsan Bajwa^{1,2}, Asad Shabbir¹, Boyang Shi¹

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Biological invasions are one of the foremost drivers of ecosystem restructuring. Parthenium weed (*Parthenium hysterophorus* L.), a well-known noxious invasive species, has invaded diverse climatic and biogeographic regions in more than 45 countries across five continents, including the Mediterranean region. Efforts are under way to minimize the parthenium weed-induced environmental, agricultural, social, and economic impacts. However, insufficient information regarding its invasion mechanism especially under a changing climate is available. Here aspects of the mechanism of parthenium weed invasion, both under the present and a changing climate are presented. From such experimental investigation important observations are: (1) along with the lack of natural enemies in its introduced range, the weed expresses its unique, highly effective reproductive biology that is likely to be involved in its invasiveness. (2) Tolerance to abiotic stresses and ability to grow under a wide range of edaphic conditions are additional invasion tools on a physiological front. (3) An allelopathic potential of parthenium weed against agricultural and native species may also be responsible for its invasion success. (4) As experimentally determined, rising temperatures and atmospheric carbon dioxide concentrations and changing rainfall patterns, all within the present day climate change prediction range are favourable for parthenium weed growth, its reproductive output, and therefore its future spread and infestation.

Such an understanding of the core phenomena regulating the weeds invasion biology has pragmatic implications for the long-term management of this weed using biological control as a core activity. A better understanding of the interaction of physiological processes, ecological functions, and genetic makeup, within a range of environments will help to devise location-based additional management strategies for parthenium weed.

Keywords: Invasive plant species, parthenium weed, biological invasion, seed biology, allelopathy, climate change, management

Keynote Lecture 2

Predicting potential benefits and risks of biological control of common ragweed in Europe: from ecological to evolutionary studies

Müller-Schärer H¹ and the COST-SMARTER team²

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²COST-SMARTER (FA1203); <http://ragweed.eu/>

Balancing benefits with risks is key in developing a successful biological control program. Shortly after we started a coordinated research program on “Sustainable management of *Ambrosia artemisiifolia* L. in Europe (SMARTER)” in 2013, we were confronted with the accidental introduction of the North American native ragweed leaf beetle *Ophraella communa* (Col.: Chrysomelidae), which needed an urgent decision on how to respond to this unforeseen arrival. We immediately reacted by our newly formed SMARTER consortium composed of specialists in weed and invasive species management, ecology, aerobiology, allergology and economics. On the one hand, I will summarize our findings on the beetle's potential benefits, ranging from its impact on ragweed performance, demography, spread, aerial pollen concentrations up to reducing health cost. In a case study we extrapolated the change in airborne ragweed pollen concentrations observed in the Milan area colonised by the beetle to the heavily ragweed-invaded French Rhône-Alpes. We estimate that a future establishment of *O. communa* in this region alone would reduce the medical costs due to common ragweed pollen by approximately 5-7 M€ annually. On the other hand, we present our results on the risks of the beetle for non-host plants. Earlier experimental biosafety studies in the laboratory indicated a certain risk to sunflower. We experimentally tested the risk to sunflower and many other species in the field and surveyed crop fields in the beetle-colonised regions in Switzerland and Italy, particularly later in the season when most ragweed plants are defoliated by the beetle. So far, we detected no impact on sunflower,

probably because the window of vulnerability of this crop does not coincide with high beetle densities. Also, we found no significant damage of *O. communa* on taxonomically closely related ornamental and endangered native plant species so far. We now aim to improve predicting the future long-term benefits and risks of this potential biological control programme to assist decision makers. I We will present first results of a novel experimental evolutionary approach to assess the beetle's potential to select resistant/tolerant ragweed populations, as well as the beetle's potential for evolutionary adaptation to novel biotic (host plants) and abiotic (colder temperature for the yet unsuitable habitats in Central Europe) conditions, using next generation sequencing and bioassay approaches. This is the first attempt to rigorously assess the evolvability of a biological control agent and its target weed. Our findings suggest that investments of public funds to conduct a complete risk analysis of *O. communa* for Europe and, provided the non-target risks are acceptable, to redistribute the biological control candidate to other parts of Europe that are heavily infested by common ragweed, are justified.

Keywords: *Ambrosia artemisiifolia*, *Ophraella communa*, biological control, risk-benefit assessment, evolution

Keynote Lecture 3

Theoretical aspects and practical applications of weed mapping

Kraehmer H

Bayer AG H 872, Industriepark Hoechst, D-65926 Frankfurt am Main, Germany

Modern weed mapping tools allow the documentation and visualisation of weed survey results in many different ways. Statistical tools connected with mapping software can be used for the analysis of various sorts of correlations and allow predictions of the occurrence of weeds. A few European countries have a long tradition of surveying weeds in major crops. Also, data are produced for non-arable land, for aquatic habitats, and on invasive species. Recently, the mapping of herbicide resistant weeds has become an issue. The comparability of results is, however, limited as every research group does not use the same methods for the assessment of weed infestation. The ranking of the most frequent species seems, however, to allow comparable conclusions. Obvious trends can apparently only be demonstrated in 10 to 20 – year - intervals. For example, *Viola arvensis* and *Poa annua* seem to become more frequent weeds in cereals of northern European countries whereas *Ambrosia artemisiifolia* gained considerable importance as a weed in Hungarian arable fields within the last decades. *Galium aparine* is a cereal weed that became more frequent in French fields within the last twenty years. The graphical depiction of weed distributions often suffers from some lack of precision. Systematic mapping and the demonstration of patterns in space, however, often lead to an evident correlation of factors influencing the distribution of weeds such as environmental factors or local cropping traditions. Such correlations can be used for the development of habitat suitability and species distribution models. Camera assisted weed mapping is a tool used in precision farming. This tool serves specific chemical or mechanic weed control strategies. Data produced on farms will become part of Agriculture 4.0 systems. They will, however, belong to farmers and will not be easily available for everybody. For this reason, it will be

necessary that members of the Weed Mapping Working Group of the EWRS will continue documenting long term weed shifts. These data will be required for the prediction of potential weed problems and changes of agricultural and non-agricultural habitats.

Keywords: Weed mapping, weed surveys, methods

Keynote Lecture 4

Current status as agricultural weeds of selected alien species arrived in Greece at a wide span of years

C.N. Giannopolitis

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A number of selected alien plant species that were introduced into Greece either many years ago or more recently are reviewed for their current distribution throughout the country and their significance as agricultural weeds. The plant species include *Oxalis pes-caprae* L., *Ailanthus altissima* (Mill.) Swingle and *Solanum elaeagnifolium* Cav. that arrived in Greece as early as more than 50 years ago. They also include *Conyza sumatrensis* (Retz.) E. Walker, *Panicum dichotomiflorum* Michx., *Ipomoea hederacea* Jacq. and *Sicyos angulatus* L. that arrived at different times more recently. Species of the oldest invasions have already shown their ability to establish in a variety of habitats but their weedy potential is variable and *Oxalis pes-caprae* particularly has proven its usefulness as a winter cover crop for soil protection in orchards and vineyards. Species of the newest invasions, on the contrary, seem to spread very slowly and have currently a rather limited distribution but they have already become very important weeds for many crops in areas where they have been established. Factors that seem to have affected spread, distribution and weediness of the above species will be discussed.

Keywords: Weed, alien species, spread, distribution

Session 1

Weed seeds, germination and early growth

Chaired by Kirsten Torresen

Oral 1

Germination and growth characteristics of wild oats

Süleyman Türkseven¹, İsmail Can Paylan¹, Ahmet Uludağ^{2,3}, Mehmet Demirci⁴, Deniz Çapkan¹

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Wild oats (*Avena* spp.) are problems in many crops including wheat in Turkey. Wild oat seeds were collected from 377 wheat fields and identified as *A. ludoviciana* (*A. sterilis* subsp. *ludoviciana*) (AL), *A. fatua* (AF), and *A. sterilis* (*A. sterilis* subsp. *sterilis*) (AS). Their germinations and developments were studied with selected populations which are two for each species. No germination difference was found among three *Avena* species. Early growth of three species was similar as well: all at 9 BBCH level at a week after seeding (WAS), 11 for AS and AF and 12 for AL at two WAS, mostly 12 at three WAS, mostly 13 at four WAS, mostly 14 at five and six WAS, 22-23 at seven WAS, 22-24 at eight WAS, 23-25 at 10-12 WAS, 24-26, at 11-15 WAS. However, maturing (reaching 99 BBCH level) of species varied: 28 WAS for AS, 29 was for AF and 30 WAS for AL. It could be concluded that application time for current herbicides are similar dates for all species.

Keywords: *A. ludoviciana*, *A. fatua*, *A. sterilis*, BBCH, growth

Oral 2

Effect of soil disturbance on seedling emergence of *Avena ludoviciana*

Taab A*, Hatami P, Shokri, Z, Amini E

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Avena ludoviciana, is a dominant weed species in winter cereal crop mostly in wheat in Iran. It is a continuous problem due to monocropping, consistent cropping system and lack of efficient control measures. Soil disturbance regimes may affect seedling emergence of weed species in the cultivation.

Therefore, the aim of this study was to test the effect of soil disturbances on seedling emergence of *A. ludoviciana*. Three populations (2 from west of Iran and 1 from northern part of the country) were collected in wheat fields in late spring 2016. The treatments were sowing seeds at soil surface, simulating zero tillage; sowing seeds at the depths of 0 to 5 cm and 0 to 15 cm simulating reduced and conventional tillage, respectively. 100 seeds were sown per pot, with four replications. Sowing was performed in 25 cm diameter pots in November 2016. The pots were buried in the soil outdoors. Samplings were done every 2 days by destructive counts, from late autumn to early winter 2016. Seedling emergence mainly took place in end of December 2016 to early January 2017. Statistical analysis showed a significant difference among populations and soil disturbance regimes in total seedling emergences. Total seedling emergence was between 1.8 to 5.8 % in all populations for seeds buried at soil surface. It was between 9.3 to 26 % for seeds buried at the depth of 0 to 5 cm and between 1.8 to 11.8 % for seeds buried at the depth of 0 to 15 cm. Thus, seedling emergence was low for seeds buried at the soil surface, it increased for seeds buried at the depth of 0 to 5 cm followed by a decrease for seeds buried at the depth of 0 to 15 cm. It is concluded that zero tillage may result in reduced number of emerged

seedlings compared to reduced tillage in *A. ludoviciana*. Deeper burial of seeds may also result in reduced numbers of emerged seedlings. However, burial of seeds in deeper layers of soils by heavier soil disturbance may lead to building of long term soil seedbank in addition to accelerating loss of water from the soil. Thus, it may not be a beneficial operation to adapt consistently. Reduced tillage may be only considered for stimulating larger numbers of seedlings to emerge and reduction of soil seedbank. Comparatively, zero tillage could be a beneficial operation to adapt due to reduction of numbers of emerged seedlings of *A. ludoviciana*, in addition to exposure of seeds to possible predation and conservation of soil moisture. The effect of tillage on *A. ludoviciana* and also other weed species needs to be tested in field trials.

Keywords: Seedling emergence, soil disturbance, tillage, weed

Oral 3

Emergence of *Echinochloa crus-galli* populations through a climatic gradient

Royo-Esnal A¹, Loddo D², Necajeva J³, Jensen PK⁴, de Mol F⁵, Economou G⁶, Taab A⁷, Bochenek A⁸, Synowiec A⁹, Calha I¹⁰, Andersson L¹¹, Uludag A¹², Uremis I¹³, Torresen KS¹⁴

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Echinochloa crus-galli is a summer annual weed, whose long emergence period and fast growth makes its control difficult. This noxious weed is restricted to irrigated crops, like maize or rice, in the Mediterranean, but can also appear in rain fed cereals in temperate climates. Due to the climate change that is occurring nowadays, *E. crus-galli* is invading new latitudes and expanding its presence to new areas. Under this perspective, in this work the emergence of several populations was studied throughout Europe and the Middle East: Denmark, Germany, Greece, Italy, Iran, Latvia, Norway, Poland, Portugal, Spain, Sweden and Turkey. Two common populations, the first harvested in Norway in spring barley and the second in Italy in a maize field, were established in all locations, together with two-three local populations in each site. The local populations were collected from surrounding crops in each site, most of them from maize fields, but also from rice, cereals, vegetables, garden or orchards. Sowing was performed in 25 cm diameter pots in October 2015 by disturbing the upper 5 cm of the soil. 200 seeds were sown per pot, with five replications. The pots were buried in the soil. In those sites where *E. crus-galli* appears only in irrigated fields, pots were watered. Samplings were done every 2-3 days by destructive counts, from late March to July-September 2016, depending on the site. The emergences varied significantly between locations. The common

population from Norway showed higher emergence rates in Northern latitudes (47-63% in e.g. Denmark, Norway, Sweden, Poland) than in Southern latitudes (8-14% in Iran, Italy, Spain). In the case of the common population from Italy results were more homogeneous, although highest percentages of emergence occurred in Southern latitudes (37-47% in Iran, Italy, Spain) and lowest in Northern latitudes (20-35% in e.g. Denmark, Norway, Sweden, Poland). With respect to the highest emergence percentages in each site, the Norwegian population emerged more in Poland, Denmark, Norway, Sweden and Latvia; the Italian population did the same in Iran, while local populations showed more emergences in Spain and Italy. In general higher emergence percentages were observed from populations collected in maize field compared to populations collected in rice, orchard or garden populations. With regard to the emergence rates, these did not differ between the different populations in each site, although the Norwegian common population usually emerged some days earlier (2-7) than the other populations (Italian and local ones). *E. crus-galli* showed quite high plasticity in the emergence depending on the biotype. Climate of origin and the original habitat (crop type) significantly conditioned the quantity of the emergences, but not the emergence rate.

Keywords: Barnyard grass, biotype, climate change, habitat, temperature, soil moisture

Acknowledgement: This study was a joint experiment conducted by the EWRS Working Group Germination and Early Growth. Full address list of participants can be given on request.

Oral4

A growth model for *Lolium rigidum* with and without fertilization and crop competition

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This work presents the preliminary results of a common experiment carried out by the members of the Biology and Agroecology Group of the Spanish Weed Science Society. *Lolium rigidum* represents a worldwide problem as a weed species and, in several cases, it has developed herbicide resistance. Its presence can considerably reduce the economic return of cropping activities, either by causing yield losses or by requiring the adoption of more costly weed control methods. Furthermore, the control of this weed is very often unsatisfactory, which could be due, at least partly, to untimely application of weed control measures. Therefore, the development of models that can reliably predict the emergence and early growth of weeds seems to be a crucial issue to build adequate Decision Support Systems (DSS) for the application of Integrated Weed Management practices. In this sense, the greatest effort so far has been focused on the emergence of weed species, but very little is known on their early growth. The objective of this work is to develop an early growth model, mainly based on photohydrothermal time (PhHTT). *Lolium rigidum* seeds were sown in the autumn 2016 in three different conditions: without crop, in competition with winter barley, and in competition with winter barley and phosphoric fertilization. Sowing was performed in 0.25 m x 0.25 m quadrats, at a rate of 100 seeds per plot, with four replicates, by disturbing the upper soil layer down to 2 cm. Barley was sown at 200 kg/ha (12 seeds per plot in two rows).

Fertilization was added at the time of weed sowing. Growth was recorded based on phenological development, according to the extended BBCH scale. Assessments were made every 2-3 days (three times a week) on three seedlings per plot (a total of 12 seedlings), until the 5-leaf stage in the main shoot. PhHTT was calculated by first estimating the hydrothermal time (HTT) with the Soil Temperature Moisture Model, considering the soil temperature down to 2 cm, and moisture at 4 cm depth; daily HTT was then corrected based on day-length. Accurate models could be developed for each growing condition. *Lolium rigidum* seedlings grew significantly faster in competition with the crop, while additional fertilization seemed to have little effect. The different growing rates with and without inter-specific competition denote the importance of considering the inclusion of the crop for the development of models that could describe the growth in a more realistic way to be implemented in DSS.

Keywords: barley, BBCH scale, crop-weed competition, non linear regression.

Acknowledgements: This project was financed in part by Catedra Adama of the University of Sevilla and the Spanish Weed Science Society (SEMh). Erasmus+ grant financed the stage of the third author in Lleida while analyzing the results.

Oral 5

The effect of burial depths on seasonal germination of different weedy rice biotypes

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Currently, weedy rice (*Oryza sativa* L.) is one of the most serious threat to rice production because its highly adaptable species owing to flexibility in the timing of seed germination, variable growth forms, multiple annual lifecycles, cold tolerance, high dispersal ability, and high genetic diversity. Weedy rice varieties are a phylogenetic group under the genus *Oryza* because they share phenotypic and genotypic of the characteristics of two cultivated species *Oryza sativa* L. and *O. glaberrima* Steud. To improve management systems for weedy rice, it is critical to have good information on seed dormancy because it's one of the most important variable physiological and morphological characters in weedy rice populations. Seeds of 76 straw hull weedy rice biotype were collected from a natural population in rice (*Oryza sativa* L.) fields in main growing regions of Trachea, South Marmara and Black sea region of Turkey in early September 2014. Three different biotypes were found, and biotypes were classified as long awn, short awn and awnless. For each seed biotype, 250 seeds were wrapped with a plastic fabric and placed on the soil surface, or buried at 5, or 10 cm in pots (diameter, 20 cm; height, 25 cm) at the end of September 2014. Nylon mesh fabric was used to create conditions close to natural soil conditions (water, air, and, microorganism diffusion). A total of 384 pots were used for each biotype (4 depths, 24 exhumation times, and 4 replications). The experimental burial conditions were either flooded (no drainage holes in the pots) or non-flooded (drainage holes). Four samples, one from each replicate, were exhumed from each depth from the burial treatments at monthly intervals for 24 months, starting in the end of October 2014. The germination tests were conducted in a growth chamber at 25/15°C with a

12/12 h night/day regime. In general, long awn biotype had high seed germination, nearly close to 90-96% in all depths at the beginning of experiment either flooded or non-flooded conditions. This is proving that it has weak or no primary seed dormancy. Contrary to long awn biotype, short awn had low seed germination and it did not exceed 54 % at the first month of exhuming. Seeds of this biotype have a moderate level of primary dormancy. Seasonal changes in germination of awnless seeds in the burial experiments differed significantly among depths ($P < 0.001$). The seeds of this biotype buried in the field were dormant at the beginning of the experiment from October to March in non-flooded conditions. This biotype was germinated in spring, become dormant in fall and again germinated in spring in both conditions. This seed showed strongly cyclic behavior and typical cyclic changes in germination were repeated with slight variations in the subsequent months.

Keywords: Seasonal germination, weedy rice, burial depth, dormancy

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Oral 6

Long-term fertilization and crop rotation effects on weed seedbanks

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Weed seed banks may reflect the status of weed population in the present and the past, and could be regarded as an indicator of the impact of soil and crop management. Crop rotation and fertilization system are among the many agronomic variables that interact with weed management to affect the size and composition of the weed seedbank. Knowledge of the effects of agricultural practices on weed seedbank dynamics is essential for predicting future problems in weed management. The aim of this study was to determine how the impact of the different growing system: monocultures of maize, 2-year crop rotation (maize, wheat) and 3-year crop rotation (wheat, maize, soyabeans) and the application of different fertilization systems: 2-year crop rotation (unfertilization and fertilization with NPK) and 3-year crop rotation (unfertilization, fertilization with manure and fertilization with NPK) affects the composition of the weed seed bank. For these surveys the plots of stationary experiment "Plodoredi", Institute of Field and Vegetable Crops, Novi Sad, Serbia (N 45° 19', E 19° 50') were used (plots were established in 1969/70). In each fertilized crop rotation was used 100 kg ha⁻¹ mineral N (50 kg in autumn and 50 kg in spring). In order to determine the weed seed bank, soil samples were taken for three years (2014-2017) in the autumn (after harvest) and spring (before sowing) and from three depths: 0-15 cm, 15-30 cm and 30-40 cm. The seedling emergence method was used to assess the emergence of the 432 soil samples. The method was carried out under controlled conditions of

greenhouses for 12 weeks with the daily determination of seedling. The largest number of seedling was observed between 3 and 6 weeks, in samples taken from the ploughlayer (0-15 cm). It was concluded that the smallest number of species present (8) in maize monoculture samples was recorded (at the depth 0-15 cm there were 6 species, at 15-30 cm 5 species and at 30-40 cm 4 species). While the change in maize with wheat increased the number of weed species to 12 (0-15 cm: 11 species; 15-30 cm: 9 species; 30-40 cm: 5 species) and 17 respectively in the rotation of maize, wheat and soyabeans (0-15 cm: 10 species; 15-30 cm: 9 species; 30-40 cm: 7 species). There are 14 weed species (0-15 cm: 9 species; 15-30 cm: 9 species; 30-40 cm: 8 species) on the plots of the 2-year crop rotation where no fertilizer is applied, and in the fertilizer variant with NPK nutrients 12. In the samples with three plots of the 3-year crop rotation and different varieties of fertilization, a similar number of weed species were observed, but they differ in the floristic manner. Thus, in the non-fertilizer samples (0-15 cm: 12 species; 15-30 cm: 10 species; 30-40 cm: 7 species) the most important species were *Ajuga chamaeptyus* L., *Anagalis arvensis* L., *Sorghum halepense* L., *Stachys annua* L. In the plots where a manure is applied every three years in the amount of 40 t ha⁻¹ *Ambrosia artemisiifolia* L., *Chenopodium hybridum* L., *Chenopodium album* L. *Veronica hederifolia* L. are dominated. At the depth 0-15 cm there were 8 species, at 15-30 cm 12 species and at 30-40 cm 7 species. Only during the using samples at this locality, a large populations of invasive species *Helianthus tuberosus* L. is observed. In the area of Serbia in occational years when climatic conditions permit this species is propagated generatively. Normally it is maintained in the form of tubers in the soil weed seedbank. In the samples where only NPK fertilizer was applied, the state of weed species was similar (17 species) but *Datura stramonium* L., *Polygonum aviculare* L., *Portulaca oleraceae* L. occured, too.

Keywords: weed seedbank, maize, seedling emergence method, crop rotation, fertilization.

Session 2

Invasive alien plants and ecological aspects

Chaired by Sava Vrbnicanin

Oral 7

Invasive weeds in agriculture

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Following is the list of species playing a role as new weeds in Switzerland, including some solutions for weed control:

- Millets (mostly annual grasses) were present since ancient times. Maize cropping allowed the propagation of millet in arable land. The invention of triazine-herbicides stopped the invasion until the first weed (*Chenopodium album*) got resistant to triazines (1977).

- Invasive *Ambrosia artemisiifolia* produces highly allergenic pollen menacing human health and is a summer annual dicotyledonous agricultural weed. Many herbicides can control it, but the legal obligation (invented 2006) has the best effect. This obligation forces farmers to adapt their weed control to this species.

Invasive *Solidago canadensis* (perennial) growing in wild flower strips (ecological compensation) became an issue because its abundance reached in individual cases more than 60% ground cover, forcing to abandon wild flower strips and include the area again in arable production. *S. canadensis* does not stand soil cultivation. Garden centers sell sterile ornamental *S. Canadensis*.

Exotic *Heracleum mantegazzianum* and native *Veratrum album* or *Rumex obtusifolius* invade mountain pastures as well. Herbicides are available for plant-by-plant treatments.

- *Colchicum autumnale* (native, poisonous, biannual, vegetative propagation by bulbs) profits from general regulations for ecological compensation, which are not well adapted to all climate zones. Extensive prairies in the Jura Mountains and in the pre-Alpine landscape cannot be mowed before 15 June. This allows *C. autumnale* – as well as poisonous *Senecio aquaticus* – to propagate well. An herbicide to control them in these near-natural prairies has recently been registered. *S. jacobaea*, poisonous as well, has accidentally been part of the seed mixtures for wild flower strips until farmers complained.

Cyperus esculentus (biannual, vegetative propagation by tubers) is presently out of control. Vegetable farmers do not have efficient solutions neither for control methods nor for preventing the distribution of tubers, often displaced from field to field by vehicles, machines and crop residues. The species is a typical example for profiting from modern farming techniques. Arable farmers are ashamed to communicate the infestation of their fields. Some partially efficient herbicides are registered in Switzerland. Agroscope is developing since a few years a control strategy.

Is *Abutilon theophrasti* (annual) the new problematic weed? It is quite common in Southern Europe and sometimes grains are found in seeds of radish cover crop. Being still rare in Switzerland, sugar beet farmers are very vigilant

- Is *Bunias orientalis* (perennial) the profiteer from tourism industries? Tourism demands in Swiss Alpine regions constant improving of transport facilities and a growing number of apartments and hotels for tourists. Construction sites create disturbed soil mostly in the best-situated land ideal for *B. orientalis* to propagate – pushing livestock farmers constantly to peripheral pastureland.

Keywords: Alien weeds, weed management, herbicide resistance, distribution

Oral 8

Ecological impact of *Helianthus tuberosus* at home and away

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Helianthus tuberosus (Jerusalem artichoke) is native to North America. It was introduced to Europe in the 17th century and is now considered an aggressive invasive plant. This work focused on describing the effects of *H. tuberosus* on species richness and diversity both in its native (North America) and non-native (Europe) ranges. We also acquired more information about arbuscular mycorrhizal fungi (AMF) colonization of *H. tuberosus* in both ranges. Interaction between the target plant and neighboring species was determined by plot surveys conducted along 11 freshwater streams in its native range and 29 freshwater streams in its non-native range. AMF colonization of *H. tuberosus* (64 samples in North America and 56 samples in Europe) was determined by staining the roots with aniline blue. We recorded 225 species across all plots in North America and 249 species across all plots in Europe. Mean species richness was significantly lower in Europe than in North America. Similarly, plant diversity was significantly lower in Europe than in North America. However, mean plant height of *H. tuberosus* in North America was significantly shorter than in Europe. Our test for AMF colonization

indicated that all collected roots of *H. tuberosus* were colonized by AMF both at home and away, but AMF colonization of *H. tuberosus* was significantly higher at home than away. Based on our results, *H. tuberosus* exerts negative effect on species richness and diversity in its non-native range, and AMF colonization could be an important factor in the spread of the plant.

Keywords: invasive plant, Jerusalem artichoke, species richness, mycorrhiza colonization

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Oral9

Applying invasibility theories to design cover crop mixes for weed suppression

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This study explores the application of the biotic resistance, limiting similarity and resource availability theories to the design of annual cover crop mixes for weed suppression. The combination of these three theories suggests that cover crop communities with greater functional diversity, higher similarity to common weed species, and faster rates of resource capture will be most resistant to invasion by weeds. To test this hypothesis, we designed eight different cover crop mixes which varied in species diversity, functional diversity, and functional composition (spreading vs. upright plants, broadleaves vs. grasses). These were sown in 84 m² plots in a randomised complete blocked design on two farms in South Africa's winter rainfall region, an area where *Lolium rigidum* is the most abundant and problematic weed. Each mix contained either a single species, four species, or twelve species of legume, cereal and brassicas, sown in equal proportions according to locally recommended seeding rates. Indicators of resource uptake by each mix in terms of soil nitrogen, soil water and light reaching the soil were measured at five time points from establishment in autumn until termination via a roller-crimper in spring. Plant dry weight for each species of cover crop and weed within each mix was measured twice, at approximately 90 and 130 days after planting. Results indicate that rates of resource uptake by individual cover crop species are more important to weed suppression than the diversity or functional composition of cover crops, and rapid uptake of the limiting resource may be most important. Resistance to invasion by weeds in annual cover crops can therefore be increased by using crop species capable of rapid resource uptake.

Keywords: weeds, cover crops, resource availability, biotic resistance, limiting similarity

Oral10

Amaranthus palmeri in northeast of Spain. A pioneer process of invasion?

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Amaranthus palmeri S. Watson is one of the most noxious weeds in the South of USA and Mexico. Its competitiveness is enhanced by its capacity to develop different resistance mechanisms to herbicides, including glyphosate. This species is also present in other continents causing great difficulties to control and has been included in 2014 in the EPPO Alert List due to the potential risk for Europe. Since 2008, *A. palmeri* was observed in three different localities of northeast of Spain, showing a stable seed bank across years. According to the presence of these three populations at a relative short distance range between them (approximately 50 km), two questions are proposed: a) Does this presence respond to different introduction processes or they came from an original introduced population with a posterior anthropic spread? b) Are there differences in some biological attributes in comparison to other local *Amaranthus* species? With the aim to respond these questions two different studies were carried out: (1) at molecular level to identify possible parental relationships between the three populations, and (2) analysing their germination requirements in comparison to those showed by other local *Amaranthus* species. The germination analysis included seeds of the three *A. palmeri* populations and from four other local species (*A. retroflexus*, *A. hybridus*, *A. viridis* and *A. powellii*). Two different assessments were established: one was carried out at different constant temperatures (5, 8, 11, 14, 17, 20, 23, 26, 29 and 32 °C) at two contrasting light conditions (darkness vs. 12/12h photoperiod); the other at three different alternating temperatures (10/20 °C; 15/25 °C; 25/35 °C)

and two light conditions (darkness vs. 12/12 h photoperiod). For the molecular analysis, ten plants of each *A. palmeri* population were considered. Seven ISSR (Inter Simple Sequence Repeats) markers were used and the fragments of DNA amplified by PCR (Polymerase Chain Reaction). The three populations of *A. palmeri* showed, at optimal temperatures (25-35 °C) and photoperiod had a greater germination speed and germination capacity at low temperatures (< 20 °C) and darkness than the other local *Amaranthus* species. The analysis by molecular markers reflected a similarity index of 75% between the three populations, and an index of 86% for two of them. These results appointed that the three populations came from the same process of introduction, and as result of an adaptive process, they show greater germination plasticity than other local species of *Amaranthus*.

Keywords: Exotic weed, germination, invasive, molecular analysis, parental relationship.

Session 3

Mapping weeds in agricultural fields

Chaired by Alireza Taab

Oral 11

A weed survey in rapeseed fields in west of Iran

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Rapeseed was introduced in the cropping systems of west Iran during last decade. Rapeseed may affect weed species composition (especially those from Brassicaceae family) in the introduced area. A weed survey was conducted in rapeseed fields in west of Iran during spring 2017. Totally 50 fields in 5 regions (10 per region) were chosen for sampling. At each field, one phytocoenological relevé plot of 50 m² was recorded in the field center. Weed species, altitude, pre-crop, production area and locality were recorded. The coverage of species was estimated using nine degree Braun-Blanquet cover-abundance scale. Monitoring was performed during the spring 2017 before weed control operations. The data were processed using multivariate analyses in the Canoco for Windows 4.5. As explanatory variables the locality, pre-crop (barley, wheat, coriander), altitude and production area (ha) were chosen. As dependent variables species cover data were used. Statistical analysis showed that the locality and pre-crop are the significant explanatory variables affecting weed species distribution. Totally 19 species were found. *Sinapis arvensis*, *Avena ludoviciana*, *Convolvulus arvensis*, *Galium tricorneratum*, *Vicia villosa*, *Lathyrus sp.*, *Lactuca serriola*, *Fumaria vaillantii*, *Erigeron canadensis*, *Erodium cicutarium*, *Malva neglecta* and *Carthamus oxyacantha* were found as the most frequent species. In terms of species cover, *S. arvensis* followed by *A. ludoviciana* and *C. arvensis* were found as the most dominant species.

Keywords: Dominance, frequency, weed cover, weed survey, rapeseed, Iran

Oral 12

Mapping wild oats in wheat fields in Turkey

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Wheat is the largest grown crop in Turkey. Wild oats (*Avena spp.*) are among the most important weed species in wheat fields. The aim of this paper is to explain distribution and map wild oats from wheat fields. Three *Avena* species were identified from 377 samples: *A. ludoviciana* (*A. sterilis* subsp. *ludoviciana*), *A. fatua*, and *A. sterilis* (*A. sterilis* subsp. *sterilis*). All three species were detected in all geographical regions of Turkey. *A. ludoviciana* was the most common species in the Mediterranean, the Inner Anatolia and the South East Anatolia Regions, *A. ludoviciana* and *A. fatua* in the East Anatolia Region, *A. sterilis* and *A. fatua* in the Black Sea Region, and three species were equally distributed in the Marmara and the Aegean Regions. Furthermore, all populations were tested if they have evolved resistance to the most common herbicides. There was multiple or cross resistance in some populations. Out of 377 populations 246 were resistant to fenoxoprop-p-ethyl, 79 to pinoxaden, 40 to tralkoxydim, 181 to mesosulfuron methyl+iodosulfuron methyl sodium, 184 to proxycarbazone sodium+mesosulfuron methyl. The data of resistance mapped according to wild oat species, provinces and herbicides.

Keywords: *Avena fatua*, *A. ludoviciana*, *A. sterilis*, herbicide resistance, mapping

This study was supported by TÜBİTAK 113 0 419 project.

Oral 13

Spatial occurrence of weeds in sunflower fields of the Evros region

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Weeds and especially *Orobanche cumana* Wallr. pose a major problem in sunflower (*Helianthus annuus* L.) production. The developments of herbicide-resistant crops (HRCs) have provided attractive options for post weed management within the recent years and hence the HRCs are dominating agricultural production systems of sunflower in Greece. ExpressSun[®] and especially Clearfield[®] have become the main technologies in sunflower production. The aims of this study were to identify, a) the changes in weed species composition in sunflower under the repeated use of the aforementioned technologies and b) the environmental and farming factors which determine the weed species composition. During two cultivation periods between July 2012 and July 2015 extensive surveys were conducted in 27 and 50 sunflower fields, respectively, across the Evros region of north Greece. In each field we sampled 10 quadrats of 1 m² following a Z pattern. Weed species in each quadrat were counted and their Abundance Index (AI) was determined. Canonical Correspondence Analysis (CCA) served to quantify the relative contribution of several variables of environment, site and crop management to weed species composition. Considerable differences in weed species composition of sunflower fields were mainly associated with N fertilization, irrigation, soil organic and clay content and time of sowing. Based on abundance index (AI) the most important weed

species during the 2012 surveys were in decreasing order: *Solanum nigrum* L., *Chenopodium album* L. *Xanthium strumarium* L. and *Sorghum halepense* L. and during 2015: *C. album*, *Echinochloa crus-galli* (L.) Beauv., *S. halepense* and *Xanthium strumarium*. Sunflower broomrape (*Orobanche cumana* Wallr.) was detected at the 26 and 28% of the surveyed fields during the 2012 and 2015 surveys, respectively.

Keywords: *Orobanche cumana*, weed species composition, fertilisation, irrigation, edaphic factors.

Oral 14

Characterization of Herbicide Resistant Wild Oats Populations from Wheat Fields in Turkey

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Herbicide resistant wild oats have been problem in wheat fields which is the foremost crop that is covering more than one third of total agricultural land of Turkey. The aim of this presentation is to quantify herbicide resistance in wild oats from wheat fields. Total 377 seed samples were collected including three *Avena* spp.: *A. ludoviciana*, *A. fatua*, and *A. sterilis*, which were 212, 92, and 73 populations, respectively. Two ALS (mesosulfuron methyl+iodosulfuron methyl sodium and Proxycarbazone sodium+mesosulfuron methyl) and three ACCase (fenoxoprop-p-ethyl, pinoxaden, and tralkoxydim) herbicides were tested. Only 82 populations were sensitive to all herbicides. Multiple resistance was common in all species: 14 populations were resistant to all five herbicides, 64 to four, 67 to three and 62 to two. Ratio of multiple resistant populations was 69% for *A. ludoviciana*, 52% for *A. fatua* and 47% for *A. sterilis*. Cross resistance was seen at two populations for ACCase and seven populations for ALS. There were 59 populations only resistant to Fenoxaprop out of 79 populations that are resistant to only one herbicide. The number of populations resistant to Fenexoprop-p-ethyl was 246 followed by ALS herbicides (181 to mesosulfuron methyl+iodosulfuron methyl sodium, 184 to proxycarbazone sodium+mesosulfuron methyl). Less population showed resistance to

pinoxaden (79 populations) and tralkoxydim (40 populations). The highest rates of resistance comparing to sensitive population were 9.49 times for fenoxaprop, 10.51 for proxycarbazone sodium+mesosulfuron methyl, 11.25 for mesosulfuron methyl+iodosulfuron methyl sodium, 14.02 for tralkoxydim, and 18.01 for pinoxaden.

Keywords: *Avena* spp., Herbicide resistance, ALS, ACCase

This study was supported by TÜBİTAK 113 0 419 project

Session 4

Mapping of weeds in agricultural fields

Chaired by Garyfalia Economou

Oral 15

Ocurrence of *Amaranthus palmeri* in citrus plantations in Adana, Osmaniye and Hatay provinces of Turkey

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Amaranthus palmeri is an important invasive weed species in the world which was not present in Turkey until it was reported in 2016. This weed was observed in some crops and non agricultural areas in Adana, Osmaniye and Hatay provinces located in Mediterranean region of Turkey. According to statements of farmers the control of this weed is quite difficult by applied local weed control practices including mechanical and chemical methods. Therefore, a survey was conducted during 2015 in the region to assess the frequency of this weed species in citrus plantations. Fifty six, 17 and nine citrus orchards were surveyed in Adana, Hatay and Osmaniye provinces, respectively located in eastern Mediterranean region of Turkey. Visited fields were first monitored for the presence of the weed in order to determine its frequency, and then ground cover of *A. palmeri* was estimated where occurred. A distance of 5 km was left between each visited field. It was observed that the frequency of *A. palmeri* was 15.9% in the whole surveyed area, whereas the highest frequency was in Osmaniye province (55%), followed by Hatay (31.3%). In Adana province only 2 locations (3.5% frequency) were infested with *A. palmeri* and both were located in Ceyhan town, which is neighbour to Osmaniye and Hatay provinces. Mean ground cover of the weed in infested fields ranged between 0.5 and 60%, whereby both citrus plantations in Ceyhan town and some plantations in Osmaniye provinces had quite high cover rates reaching up to 50 %. In Hatay province mean ground cover was between 3-5 % inside the

infested fields, showing that the weed was later introduced to these areas presumably from Ceyhan town and Osmaniye province and has not yet been a particular problem. Although these surveys were performed in Citrus plantations in the region, *A. palmeri* was also widely observed in maize, sunflower, cotton and peanut fields as well as on non agricultural areas such as road sides and around irrigation channels, especially in Ceyhan town and Osmaniye province. These results showed that *A. palmeri*, a potential invasive weed species for Turkey, has become widespread in citrus growing areas in East Mediterranean Region of Turkey. Based on the farmers statements this weed is difficult to control with local weed control practices, so special attention should be paid to control of this weeds to avoid the invasion potential. Some studies are being carried out by our working group to control *A. palmeri* in the region.

Keywords: *Amaranthus palmeri*, Citrus, Eastern Turkey

Acknowledgement: Studies were financially supported by Monsanto Europe S.A.

Oral 16

***Ipomoea hederacea* (L.) Jacq. in Greece: Biology, control and current status of infestation**

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Ipomoea hederacea (L.) Jacq., also known as ivyleaf morning glory is an annual, climbing plant of the Convolvulaceae family. It is an alien invasive species in Greece, where it was introduced about 20 years ago, causing serious problems in summer crops. The current study was prompted by the lack of information on the biology of *I. hederacea* under Greek conditions, aiming ultimately to gain knowledge that could assist measures to control this weed. Biological characters studied included the germination potential of ivyleaf morning glory seeds in relation to time and burial depth and its vegetative propagation capacity. Control options and current status of the weed infestation in Greece are also discussed.

Keywords: Weed biology, burial depth, weed propagation

Oral 17

Distribution of horseweed species in citrus orchards and vineyards in Mediterranean and Aegean region of Turkey

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Horseweed species (*Conyza* spp.) are among the important invasive weeds, which have spread to not only undisturbed soil but also agricultural areas such as, citrus orchards and vineyards in Turkey. Avoiding integrated weed management practices and sustainable use of pesticides caused an increase in the fields infested by horseweed species over the time. A regional survey was conducted to investigate the occurrence and frequency of horseweed species in vine and citrus orchards in Aegean and Mediterranean Regions in Turkey over the growing period in 2015-2016 where nearly 90% of citrus and about 50% of vine production fields were covered. The taxonomic discrimination of horseweed species (*Conyza canadensis*, *C. bonariensis*, *C. sumatrensis*) at seedling stage is not straightforward; therefore, molecular techniques were employed to identify the weed species. PCR and DNA sequence analysis were performed on genomic DNA extracted from the fresh leaf samples. In Aegean and Mediterranean Regions, 131 citrus orchards and 121 vineyards were visited and 203 horseweed populations were collected. According to the molecular analysis results, the most common horseweed species in citrus was *C. bonariensis* (was detected in more than half of the visited citrus fields) and followed by *C. canadensis* with 32%. In vineyards, *C. canadensis* was dominant species with 55%, abundance of *C. bonariensis* and *C. sumatrensis* were 27% and 18%, respectively.

Keywords: Horseweed, citrus orchard, vineyard, PCR, DNA sequence analysis

Oral 18

Native and established plant species newly occurring on arable land in the Czech Republic

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A species spectrum of arable weeds in a particular field is not constant. Weed species react to changes in the crop structure and cropping systems (especially herbicide use) and also changing climate. Susceptible species decrease their occurrence and consequently they can completely disappear while new species can enter the field. On one hand we have invasive weed species, non- native in the region, spreading as a result of their introduction and colonisation. But there are also native species or well established species that were not known from the past as serious arable weeds. Species such as *Vulpia myuros*, *Lolium multiflorum*, *Sisymbrium loeselii* and *Onopordum acanthium* were frequently found in Czech crop stands during the last few years. While *V. myuros* was not known from arable land in CZ, the occurrence of other above mentioned species in crop stands was rare and temporal. *V. myuros* is a drought resistant overwintering annual grass with a high tolerance to herbicides. It became locally frequent in winter cereals, especially in winter wheat. *L. multiflorum* is grown as an intercrop or undersown mostly in organic farming. Not only volunteer plants can be found; species can reproduce and create self-sustaining populations. Because of its biology *L. multiflorum* is most common in winter cereals. *S. loeselii* as a member of the *Brassicaceae* family is hard to control in winter oilseed rape stands. Formerly a ruderal plant it started to spread along roadsides and soon invaded arable land. Till now it is occurring mostly in field margins, but there are already fields with whole area heavy infestation. *O. acanthium* is a robust competitive plant. There are many reports of its occurrence in oilseed rape, but also in wide row crops including vegetables. This year

we also detected the occurrence of *Anthriscus caucalis* on arable land. In one case it was a dense canopy in an oilseed rape field margin and in a second case we found few plants in an oil seed rape stand. Plants were flowering and produced seeds soon after the end of the oilseed rape flowering period. This species is classified as strongly endangered in CZ. As the share of winter cereals and winter oilseed rape in the sowing area in our country is high we can predict a future spread of these species and their increasing importance as arable weeds.

Keywords: *Vulpia myuros*, *Lolium multiflorum*, *Sisymbrium loeselii*, *Onopordum acanthium*, *Anthriscus caucalis*

Session 5

Management of invasive alien plants and weeds

Chaired by Ahmet Uludag

Oral 19

Biology and management of parthenium (*Parthenium hysterophorus* L.) in India

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Parthenium (*Parthenium hysterophorus* L.) is the major problematic invasive weed found in India. It was found to invade the major crops like wheat, rice, sorghum, maize and pastures in various parts of India and world. It releases enormous amount of pollen grains which tend to cause allergy, asthma and dermatitis in human beings. The present paper deals with its distribution, biology and management strategies in coastal region of Puducherry, India. Distribution of parthenium was observed in majority of villages (87.5%) in this coastal region. Weed biology studies clearly indicated that parthenium is multibranched with 1543 to 3563 flowers per plant in coastal ecosystem. As a part of management strategy, allelopathic potential of different tree species were tried on germination and growth of parthenium seeds under controlled condition. Higher inhibition of parthenium germination was observed with eucalyptus (*Eucalyptus* spp.) and leucaena (*Leucaena leucocephala* (Lam.) de Wit) leaf leachate (100%), in comparison to control. Managing the parthenium as manure for crop production was also studied under field condition. The result of the study revealed that parthenium biomass incorporation as manure enhanced the grain yield of rice by 10.7% compared to non-incorporation. Thus, results of this studies support the use of suitable management strategies for restricting the further spread of this invasive weed to newer areas.

Keywords: Biology, management, parthenium

Oral 20

Biology, impact, and management of serious invasive weed, *Sonchus oleraceus* L. in Australia

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The status of *Sonchus oleraceus* was forced to be raised from relative obscurity to a most widespread, troublesome and economically damaging invasive weed in Australia, particularly in the northern region from central Queensland to northern Wales because of important shifts towards conservation tillage systems. Over the last 10-15 years, evolutionary herbicidal resistance, genetic diversity, prolific seed production, low level seed dormancy, and absence of natural predators contributes towards *S. oleraceus* success as 5th most difficult-to-control invader weed. Its seeds are capable to germinate under varying temperature and light condition and possesses the ability to germinate throughout the year in northern regions. Furthermore, seedling emergence, favoured by moist environment, is observed greater in seed present on or near the soil surface in no-till systems. Several populations have been discovered resistant to numerous herbicides, including chlorsulfuron, atrazine, and glyphosate. However, carfentrazone, florasulam, flumetsulam, bromoxynil octanate, tribenuron methyl, bromoxynil, and sulfentrazone singly or in mixture forms have been found effective in suppressing the growth and reproduction of *S. oleraceus* in small infestations. In addition, double-knock tactic would be considered an effective approach to achieve high level weed control through preventing seed set. However, integration of weed control approaches has been reported to be more reliable and efficient for the long-term control of *S. oleraceus*. This article was intended to highlight the current scenario and future prospects of this economically damaging invasive weed, particularly in Australia. Understanding related to the physiological aspects regulating the invasion biology of *S. oleraceus* will help in predicting its agro-ecological impacts and has pragmatic implications in designing management strategies.

Keywords: Sowthistle; invasion; agricultural impact; management; Australia

Oral 21

Weeds and their control in lady palm nurseries

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Lady Palm, [*Rhapis excelsa* (Thunb.) Henry] an ornamental plant, is well adapted to cooler regions of Turkey such as the Marmara and the Black Sea regions. Weeds are remarkable problems in palm nurseries especially in earlier years of seedling growing. This study was pursued in a nursery with 5500 units six-years-old palms, which were replanted as three years old seedlings to the fields from pots, in Bursa province. The active and efficient growth season for Lady Palm in this region is approximately among from the beginning of May to end of September. Producers begin to work on agricultural activities such as pruning, fertilization, irrigation, and weed control around 1st March and keep work until 15th October. The nursery was irrigated in 4-5 day intervals, and fertilized in 8-10 day intervals. Weed management was performed mechanically including garden hoeing machine between rows in 21 day intervals, and labor supplementation on rows in 28 day intervals. Each hoeing application including by machine and by hand took about 15 days. There was no chemical control, because of the negative effects on palm, such as growth retardation and lack of recommended herbicides. Observations and records about weeds were made on 130 x 70 cm² plots which cover a palm sapling with 11 replicates before all mechanical control operations from 1st April 2015 to 30th May 2017. According to interviews between producers and periodical observations: for summer-autumn season *Cyperus rotundus* L., and *Portulaca oleraceae* L.; for winter-spring season *Urtica dioica* L., and *U. urens* L. were identified as the most dense and difficult to combat weeds. The formation time

between two leaflets which emergence consecutively on the same palm is the clearest expression of growth and development. Observations and practices showed that the stress occur by weeds has inhibitor effect on the time among leaf formations on Lady Palm, which results in height loss. Therefore, intensive and effective mechanical control is an obligation for weed management in Lady Palm nurseries because of lack of registered herbicides in Turkey and the critical negative effects of weeds. The height of ornamental palms is the main determinant of price.

Keywords: *Rhapis excelsa*, non-chemical methods, weed management, invasive plants, palm nurseries

Oral 22

Involving gardeners to identify potentially invasive plants

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Evidence from a range of countries confirms that the escape of ornamental plants from gardens is the main pathway for plant invasions and may be accelerated considerably by climate change impacts in the future. Long delays from the introduction in a garden to the recognition of a problematic invasive plant in the wild make effective control strategies very difficult and often impossible. This study builds on the hypothesis that gardeners will notice first if ornamental plants show characteristics, e.g. vigorous growth, spread and difficulty to control, that may contribute to their potential to become a problematic invader. We used a citizen science approach to ask gardeners in Britain to report ornamental plants that are spreading and difficult to control in their gardens. We also asked how the plants reported had come into their gardens, about their management, and where new plants were sourced from. Our results show that the most frequent plants reported are also frequently recorded outside cultivation in Britain. However, the list of reported plants also includes species with a recently increasing distribution and species not reported outside cultivation. The results provide evidence that gardeners' knowledge could help to identify potentially problematic invasive plants early in the invasion process. At the same time, however, raising awareness for the problem by actively involving gardeners could be of equal importance for the prevention of ornamental plant invasions in the future.

Keywords: Invasive plants, citizen science, gardeners, early detection, monitoring

Session 6

Invasive alien plants and climate change

Chaired by Heinz Mueller-Schaerer

Oral 23

Rapid evolution of a plant invader in response to global warming

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Biological invasions by alien plants typically involve human-aided long-distance dispersal of species to regions where they have not previously occurred and which they cannot reach naturally. Importantly, climate change is likely to impose selection on invasive plant populations. The main objective of this experiment is to get insights into the evolvability to global warming of one of the most prominent European plant invaders, common ragweed *Ambrosia artemisiifolia* (Asteraceae). In an ongoing field selection experiment in Northern Italy we grow artificial populations of *A. artemisiifolia* (each founded with 120 individuals from 60 mothers collected in 20 populations) subjected to ambient or elevated (+3°C) temperatures, with five replicates of each treatment. To test for evolutionary changes in the early stage of this selection experiment, we collected seeds from the first offspring generation (F1) and grew offspring from both treatments alongside their parents in growth chambers under ambient 17°C/22°C (8h/16h) or elevated temperature 21°C/26°C (8h/16h) conditions. In each chamber, there were 100 mother plants (2 individuals from each of 50 mothers, F0), 100 F1 plants from the ambient and 100 F1 plants from the elevated temperature field populations, altogether 600 plants in the two chambers. We asked the following questions: (1) how much initial standing genetic variation was there among the *A. artemisiifolia* mother plants, and (2) can we already observe evolutionary divergence between the two different temperature

regimes? Amongst others, we found that a strongly variation of plasticity to two temperature treatments among F0 mother plants, which suggest a genetic variation of temperature plasticities. We also found the F1 plants from elevated temperature perform differently in both phenology and growth than F1 plants from ambient temperatures in the ambient temperature growth chamber but not elevated temperature growth chamber. Moreover, our results showed the variance of phenotypic traits were reduced among the F1 individuals from elevated temperature populations compared to the other populations. This study will improve forecasting of the spread of invasive alien plants in a changing world.

Keywords: *Ambrosia artemisiifolia*, biological invasion, climate change, genetic variation, rapid evolution.

Oral24

Soil moisture and temperature during reproductive growth controls seed dormancy in *Alopecurus myosuroides* Huds.

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The sustainable management of unwanted vegetation in agricultural fields through integrated weed management strategies requires detailed knowledge about the maternal formation of primary seed dormancy, in order to support the prediction of seedling emergence dynamics. This knowledge is decisive for timing of crop sowing and non-chemical weed control measures. Studies under controlled environment have already demonstrated that thermal conditions and, to some extent, water availability during seed set and maturation has an impact on the level of dormancy. However, it is still unclear if this applies also under field conditions, where environmental stressors and their timing are more variable. We studied the effect of cumulated temperature and soil water availability during the reproductive growth phase of *Alopecurus myosuroides* on primary dormancy under field conditions. The study was carried out in south-western Sweden over three years. Empirical models differing in focus time intervals and focus soil depths were compared regarding their predictive power. A two factorial linear model containing temperature sum between 0 and 14 days before seed shedding as well as the number of days with soil water potential below field capacity between 14 and 35 days before seed shedding showed the highest predictive power for the level of primary dormancy of *Alopecurus myosuroides* seeds. For soil water availability it was found that only the top 10 cm soil layer is of relevance, which is in line with the shallow root

architecture of *Alopecurus myosuroides*. This study highlights that the level of dormancy is depending on the magnitude and timing of temperature and water availability during the reproductive growth phase. Water availability appears to be more important during maternal environmental perception and temperature during zygotic environmental perception. Considering the presented model as a decision support tool for integrated weed management could support the implementation of a knowledge driven decision making process, optimizing the timing of crop sowing and weed control measures.

Keywords: Black-grass, germination control, integrated weed management, soil seed bank dynamics

Oral25

Temperature influences *Ambrosia artemisiifolia* development and pollen allergenicity

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Ambrosia artemisiifolia (common ragweed) poses a serious threat to agriculture and human health both in its native and invasive range. Concerning health, ragweed pollen is one of the most important seasonal allergen source, causing pollinosis in many regions of the world. Such health impact has increased over the last decades in parallel with the spreading of the species that has been predicted to further expand as a consequence of climate change. Thus, the assessment of temperature effects on plant growth and allergenicity is a priority for the management of the species. The present work was carried out with this aim. Common ragweed plants were grown in controlled conditions at three temperatures: “high” (30-26°C light-dark), “intermediate” (24-20°C light-dark) and “low” (18-14°C light-dark). During plant development, vegetative and reproductive morpho-functional traits were measured. When individuals reached their maximum growth, mature pollen was collected and analyzed by slot blot technique in order to assess allergenicity. All plants completed their life cycle, producing a comparable biomass. Nevertheless, plants showed different habitus at different temperatures. At “low” temperature plants were shorter and more laterally expanded than plant grown at “high” temperature. In addition, these plants showed the lowest percentage of germinated seeds, a significant late flowering (4-5 weeks) and the highest number of male inflorescences. Concerning pollen allergenicity, the highest and lowest mean values were found for plants grown at “high” and “low” temperature, respectively. The different allergenic potential was related

to difference in pollen allergens and flavonoid content. Anyway, further experiments are needed to confirm and better define the effect of temperature on common ragweed allergenicity.

Keywords: *A. artemisiifolia*, common ragweed, temperature, development, allergenicity

Oral 26

Invasion potential of *Ambrosia artemisiifolia* in Scandinavia under consideration of current and future climate

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This project aims to study the mechanisms behind adaptation of invasive alien plants to northern environmental conditions, with ragweed (*Ambrosia artemisiifolia*) as a model species and under consideration of current and future climate. In particular this project is going to investigate the role of phenotypic plasticity and genetic adaptation. Occasional occurrences of ragweed are documented in Scandinavia already since the 1990's but in recent years the first stable populations were found in Southern Sweden as well as single plants were found as far north as 62°N. Two different experimental approaches and one modelling approach will be realised in this project. Ragweed populations originating from different environmental zones in Europe will be grown in common garden experiments at three locations in Sweden differing in day-length and duration of the vegetation period. In addition the same populations will be grown under controlled conditions in climate chambers simulating elevated temperature and CO₂ levels. Germination and emergence as well as plant growth and reproduction will be observed over minimum three generations. The observations will allow conclusions whether phenotypic plasticity and/or genetic adaptation is the main driving force behind ragweed invasion to northern latitudes. Furthermore the experiments will reveal the effect of elevated temperature and CO₂ levels on biomass accumulation and seed production. The modelling approach will allow conclusions about future population establishment as well as to define the key life stages most critical for population growth rate.

Keywords: Ragweed, boreal zone, climate change

Session 7

Invasive alien plants

Chaired by Christian Bohren

Oral 27

Response of Three-lobed Morning Glory (*Ipomoea triloba* L.) to Some Soil Residual Herbicides

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Three-lobed morning glory (*Ipomoea triloba* L.) is an alien invasive plant species localised to Antalya Province in Turkey. The plant has been gradually spreading nearly all of the cotton fields for twenty years because cotton herbicides have reduced other arable weeds and allowing three-lobed morning glory to spread. Lack of crop rotation has also increased the severity of infestation. Growth chamber trials have been carried out to determine response of *I. triloba* to pre-emergence herbicides as indaziflam and post emergence herbicides as chlorsulfuron, mesosulfuron-methyl sodium + iodosulfuron methyl, pyroxasulfone, sulfosulfuron. Five rates of indaziflam (recommended rate (n), 0.75n, 0.5n, 0.25n, 0.125n) and three rates of post-emergence herbicides (2n, recommended rate (n), 0.5n) were employed using spray chamber. Double rates of sulfosulfuron and mesosulfuron-methyl sodium + iodosulfuron methyl provided greater growth reduction at 28 days after transplanting (86% and 83%) of *I. triloba* than did the other rates. However, control of three-lobed morning glory was >90% with chlorsulfuron and pyroxasulfone irrespective of use rate. All rates of indaziflam effectively controlled the invasive plant compared with the nontreated control, except the lowest rate. According to the results, the crops can be applied chlorsulfuron, pyroxasulfone and indaziflam should be included in the crop rotation because these herbicides provide excellent *I. triloba* control; however, field trials are needed for verifying effective control of *I. triloba* in various soil and environmental conditions because these herbicides have not been registered yet.

Keywords: *Ipomea triloba* control, indaziflam, chlorsulfuron, mesosulfuron-methyl sodium + iodosulfuron methyl, pyroxasulfone, sulfosulfuron

Oral 28

Vegetative performance of *Ambrosia trifida* L. in competition with *Ambrosia artemisiifolia* L.

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Common ragweed (*Ambrosia artemisiifolia* L.) is an economically harmful species, which is a strong competitor for natural resources and space. Crop yields can be significantly reduced or completely destroyed when ragweed reaches high densities. In addition to *A. artemisiifolia*, giant ragweed (*Ambrosia trifida* L.) is also locally present and naturalized in Serbia, especially in the area of central Backa. Its size well exceeds that of *A. artemisiifolia*, reaching a height of 4 m. Considering that *A. trifida* is currently expanding, it is expected that it will be more competitive than common ragweed once they occupy the same area, not only in crops, but also in natural ecosystems. Consequently, the aim of this study was to determine the biomass of *A. trifida* under competitive interaction with *A. artemisiifolia*. The experiment was conducted using a replacement design model, where the competitive interaction between *A. artemisiifolia* (AA) and *A. trifida* (AT) was assessed. The experiment involves six treatments with ratios of AA:AT plants as *a*-10:0; *b*-8:2; *c*-4:6; *d*-6:4; *e*-2:8 and *f*-0:10) and 10 plants per m² arranged in a completely randomized block design, with four blocks. The vegetative parameters of AT (height, width, number of leaves, dry weight) were measured in three assessments during the 2016 season and subsequently analyzed. The average values of height in the first assessment were in the range of 37-51 cm, in the second from 71-100 cm and in the third from

87-155 cm. Statistically significant differences ($P < 0.01$) were found between *f* and *e*, *f* and *e*, and *f* and *d*, and between *f* and *e* in these three assessments respectively. Plants from the F treatment reached their maximum heights in the first and second assessment, while in the third assessment the maximum height was recorded in the treatment *b*. Average width of the plants ranged from 18.5-20.5 cm (1st assessment), 16.094-20.15 cm (2nd assessment) and 17.25-34 cm (3rd assessment). As in the case of their height, maximum values of width were documented for the *f* treatment in the first and second assessment, while in the third assessment the maximum width was recorded for the *b* treatment. Statistically significant differences ($P < 0.001$) were registered in all three assessments, when comparing the treatment *f* with the *e* and *d* treatment. The average number of leaves in the first assessment was from 8.03-9.625, and from 11.875-13.125 in the second, where AT formed the highest number of leaves in treatment *f*. Statistically significant differences ($P < 0.001$) were recorded only in the first assessment between treatments *f* and *c*, and *f* and *e*. In the third assessment, the average number of leaves was the highest in the treatment *b*. The average dry weight values ranged from 5.8-11.49 g in the first assessment, 7.4-11.63 g in the second and 8.96-14.15 g in the third assessment. The relationship between treatments differed in comparison with the other parameters, which is probably the result of a different ratio of the stem and leaf weight of the plants in different treatments. The obtained results have shown the competitive capacity of *A. trifida* and its invasiveness in coexistence with *A. artemisiifolia*.

Keywords: *Ambrosia artemisiifolia* L., *Ambrosia trifida* L., competition, replacement design

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Oral29

Intrapopulation Variation in *Ambrosia artemisiifolia* L. Seed Germination

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Previous research suggested existence or lack of intrapopulation variation for different weed species, and as we know, so far no data was available for *Ambrosia artemisiifolia* (common ragweed) seed germination. So, the idea of this study was to check whether intrapopulation variation in common ragweed germination exists. The aim of the research was to estimate the difference in final germination and germination speed between seeds collected from 10 different plants at 100 m² of an experimental field located in the southwest Croatia (45°40'18"N 15°39'03"E). At 8th October 2014 seeds were collected separately from each previously marked plant two to three meters away from each other. Seeds from each plant were collected on the same date. Seeds were cleaned and storage at the room temperature, dry and dark conditions until the beginning of the experiment. During 2017, germination test were conducted in germination chamber with photoperiods of 12:12 (light:dark) at alternating 25/15°C (day:night) temperatures. Non-germinated seeds were subjected to tetrazolium test to distinguish dormant from dead seed. Results showed a significant ($P < 0.001$) difference in final germination and germination speed among all individuals (10 plants) within researched location, with final germination ranging from 50 to 99%. Furthermore, germination speed required to achieve 10% of the sowed seeds to germinate (t10) ranged

from 3.0 to 10.0 days, with the average of 4.7 days. According to time needed for 50% of sowed seed to germinate (t_{50}), 10 plants were divided into three groups. First group of four plants were determined to have achieved t_{50} within 4.9 to 7.6 days. Second and third group consisted of three plants achieve t_{50} within 8.4 to 11.3 days and 12.0 to 15.4 days, respectively. Finally, to reach 90% of sowed seeds germination (t_{90}) needed from 6.5 to 43.8 days, with an average of 20.9 days. Due to sexual reproduction and exchange of genetic material as well as variation in microclimate of environment and position of the seed on the mother plant, differences in germination can be observed even within the plants growing in the same location. Existence of the certain pattern in the time needed for half of the population to germinate highlights the need for creating suitable sample of mixed seeds (from different plants) to get reliable results in experiments such as estimation of biological parameters. Furthermore, high intrapopulation variation in germination of the *A. artemisiifolia* seed should be taken into consideration when extrapolating germination results and developing predictive weed emergence models.

Keywords: common ragweed, final germination, germination speed, intrapopulation variation, predictive weed emergence models

Oral 30

Germination and early growth of *Raphanus sativus* and *Echinochloa crus-galli* in the presence of water extracts of *Chenopodium album* L.

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Both, *Chenopodium album* L. and *Echinochloa crus-galli* (L.) P.Beauv. infest plantations of radish (*Raphanus sativus* L.) in Poland. *Echinochloa crus-galli* is also an expansive weed that occurs in different types of crops. Often both, *C. album* and *E. crus-galli* coexist in the field, as the most troublesome weeds. *Chenopodium album* is rich in saponins, oxalic acid and alkaloids. In this experiment we assessed the effect of water extracts (5%, 10% and 15%) of roots or leaves of *C. album* against germination and early growth of radish (cvs. 'Krakowianka', 'Półdługa' and 'Rowa') and *E. crus-galli*. Seeds of *R. sativus* and *E. crus-galli* were rinsed with tap water and distilled water, and next 25 seeds of each species separately were placed in Petri dish on 3 layers of filter paper, in 5 repetitions. The Petri dishes were kept in the incubator at 20°C ±1°C, in darkness, at a relative humidity of 60-70%. Germinating seeds were counted every 24 h, if a coleoptile of 2 mm was visible. Germination parameters, seedlings length as well as the fresh and dry mass of seedlings, and electrolyte leakage from tissues, were assessed. Based on all the measured parameters, seeds of *R. sativus* and *E. crus-galli* were more susceptible to the presence of extracts from *C. album* leaves, as compared to the extracts from roots. At the same time, seeds of *E. crus-galli* were significantly more susceptible to the extracts from *C. album* roots, as compared to the seeds of *R. sativus*. Among radish cultivars, cv. Krakowianka was least sensitive and cv. Półdługa – most susceptible to the presence of the extracts from *C. album* roots. Contrary, all the tested

species were of a very similar susceptibility to the extracts from *C. album* leaves. The 10% and 15% extracts from leaves caused a total inhibition of seed germination and the highest electrolyte leakage of both *R. sativus* and *E. crus-galli*. These results show, that the water extracts from *C. album* leaves pose a strong allelopathic effect against the germination of *R. sativus*, and therefore should be removed from the plantations of radish. At the same time, these extracts also pose an allelopathic effect against *E. crus-galli*, which might support the competitive abilities of *C. album* against this weed and also against radish.

Keywords: Allelopathy, fresh and dry weight, seedlings, electrolyte leakage, weeds

Poster Session

Poster 1

The current situation of invasive plants in Greece

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The invasive weed species are a serious threat for the rural and urban ecosystems in Europe and worldwide. The invasion of weed species affects the biodiversity and causes environmental, economic and aesthetic losses. In agroecosystems the presence of exotic plants is a major threat for crop sustainability. The invasive weeds may enter a new territory through natural ways like being carried by migrating birds or being spread by wind transportation of seeds. Anthropogenic factors may aid the invasion, such as propagation material, the lack of phytosanitary control, farming factors, the abandonment of urban spaces, the use of exotic plant species in gardening, and the lack of monitoring and immediate action. Climate change is also a serious factor that assists the spreading of exotic species. In Greece there are several invasive species that have already been established like *Ailanthus altissima* (Mill.) Swingle, *Erigeron sumatrensis* Retz., *E. canadensis* L., *E. bonariensis* L. and *Solanum elaeagnifolium* Cav. In addition, the species *Paspalum dilatatum* Poir., *P. distichum* L., *Eleusine indica* (L.) Gaertn., *Setaria adhaerens* (Forssk.) Chiov., *Echinochloa colona* (L.) Link, *Digitaria ciliaris* (Retz.) Koeler, *D. ischaemum* (Schreb.) Schreb. ex Muhl., and *Bromus catharticus* Vahl., which have been firstly recorded in Greece during the decade of 1990, have been already acclimated. Furthermore, other weeds invaded in important crops for Greek rural economy, such as corn, cotton and vegetables. The most important of them, such as *Ipomoea hederacea* Jacq., *Sicyos angulatus* L., *Panicum dichotomiflorum* Michx., *Galinsoga ciliata* (Raf.) Blake

and *Sida spinosa* L. are still at the acclimation stage. It is crucial to be alerted for weed species that may enter the country especially by taking measures to prevent the entrance and limit the expansion, particularly by means of the introduced propagation material. It is noticeable that the great occurrence of certain invasive species such as, *E. indica*, *P. dichotomiflorum*, *P. dilatatum* and *P. distichum* in the competitive crops of lawns and alfalfa, leads to the assumption of their entrance by means of the seeding material. It is also worth referring the absence of occurrence of the most serious invasive weed *Ambrosia artemisiifolia* L. In Greek ecosystems, despite its expanded distribution throughout Europe and particularly in the neighboring countries of Greece.

Keywords: Invasive weed species, Greek agroecosystems, expansion, acclimation, prevention

Poster 2

Some Important invasive alien species in agricultural fields of the Aegean Region

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Turkey is substantial in genetics, species, habitats and ecosystems variety because of having regions which have different climate and soil characteristics, located on the crossing of the Asia and Europe and having three important phytogeographical regions. Invasive alien plants are important in agricultural areas as well as non-managed areas. According to Invasive Plants Catalogue of Turkey, 52 invasive alien weeds have been described in Turkey. Some of them are important for agricultural areas in the Aegean Region such as *Conyza* spp., *Echinochloa* spp., *Xanthium* spp., *Diplachne fusca* and *Ambrosia artemisiifolia*. Some species are explained and *Diplachne fusca*, *Ambrosia artemisiifolia* are mapped in this presentation.

Keywords: Invasive alien, weed, agricultural area

Poster 3

A study on common ragweed biology in the Duzce Province of Turkey

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Common ragweed (*Ambrosia artemisiifolia*) has spread widely in the Blacksea and Marmara regions of Turkey for a decade although the first record from Turkey was from 1998. A study was conducted in 2015 and 2016 to determine population change and some biologic parameters of ragweed in the Duzce Province which is located in an area where the Black Sea and Marmara regions overlap. A method developed by Lommen et al under EU COST Action FA1203 SMARTER with slight modifications was used. Plots with size of 0.5 x 0.5 m were established in an area with natural ragweed population and kept both years. Changes in the number of plants and sizes of plants of each plot did not follow a pattern, which was increased, decreased or the same. Total invaded area increased about 20%. Both years the number of female structures (capitula), length of male structures (raceme) and dry weight were correlated with size of plants. Female structures with seed did not correlate with plant size.

Keywords: Ragweed, invasive alien species, COST, female structures, male structures

Poster 4

Occurrence of weed beet (*Beta vulgaris*) and velvetleaf (*Abutilon theophrasti*) in sugar beet stands in the Czech Republic

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Sugar beet as a wide row crop is relatively susceptible to weed competition. Weed management in sugar beet stands is intensive, in conventional farming mostly based on repeated application of contact herbicides. This system is efficient in control of majority of weed species present in fields with sugar beet except weed beet (*Beta vulgaris*) and velvetleaf (*Abutilon theophrasti*). Weed beet is a weedy annual form of the same species, thus, chemical management with selective herbicides in conventional varieties is not possible. Its occurrence in the CZ can be dated back to middle 80ies of the 20th century. Since that time it has been spreading and has become troublesome weed in all the areas with sugar beet production. First sugar beet stands with intensive occurrence of velvetleaf were found in 2000 and following years. Chemical control of this species is complicated as commonly used active ingredients are not efficient. The occurrence of this weed in sugar beet, therefore, makes management more problematic and costly.

In our field monitoring we observe sugar beet stands in main sugar beet growing areas of the Czech Republic. We collect data on the occurrence of weed beet and velvetleaf in fields by the rough estimation of population density (no occurrence; low intensity; medium intensity; high intensity of occurrence). Weed beet is frequent in all sugar beet growing areas of the country. Not all the fields are infested – still we can find some without the occurrence of weed beet at all. It is, however, important that there are many fields with a high intensity of its occurrence, limiting future sugar beet growing. One of the future options seems to be cultivation of herbicide tolerant sugar beet varieties tolerant to herbicides controlling weed beet. Velvetleaf is a typical weed in warmest regions. It is more frequent in Central Bohemia in Kolín region and also in Southern Moravia. It is still in initial phase of its invasion and we can expect further spread of velvetleaf in the near future.

Keywords: Chemical control, wide row crops, weeds

Poster 5

Determination of bio-herbicidal potential of aqueous extracts of English Ivy (*Hedera helix*) on seed germination of important weed species

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The demand for non-herbicidal approaches to weed control has increased worldwide. English ivy (*Hedera helix* L.) is a well-known invasive evergreen plant of forest ecosystems and has been reported to possess antimicrobial activities. No scientific investigation of potential bio-herbicidal effects of *H. helix* has been reported. The objectives of this study were to determine the bio-herbicidal effects of aqueous extracts of *H. helix* plant on germination of seeds of five agriculturally important weed species i.e. *Amaranthus retroflexus* L. (pig weed), *Amaranthus hybridus* L. (hybrid amaranth), *Echinochloa colonum* (L.) Link. (jungle rice), *Portulaca oleracea* L. (common purslane) and *Solanum nigrum* L. (black nightshade). Bio-herbicidal effects of *H. helix* aqueous plant extracts, prepared from fruits and shoots at various concentrations (2.5, 5.0, 7.5 and 10.0%), were investigated on seed germination under *in vitro* conditions. Fifty seeds of each of the weeds were sown in the petri dishes and were replicated five times for each extract concentration. The filter papers were moistened with 5 ml each of the extract concentrations. Both shoots and fruit extracts exhibited bio-herbicidal activities against all weed seed germination. Inhibitory effects of shoot and fruit extracts increased with the increasing rate of extract concentration. Bio-herbicidal activity of aqueous shoot extract on seed germination was generally higher than aqueous fruit extract. Results of inhibitory effects of aqueous shoot extracts of *H. helix* on seeds of all weed species revealed that all, except 2.5% extract concentration for *A. hybridus*, significantly reduced the weed seed germination. The highest inhibition on weed seed germination were obtained from aqueous shoot extract at 10.0% concentration against seeds of *S. nigrum* (81.27%). The present study concludes that aqueous extracts of *H. helix* contain potent herbicidal constituents for the management of agriculturally important weed species.

Keywords: bio-herbicide, *Hedera helix*, seed germination, weeds, weed management

Poster 6

Food web study, a community approach for biological control of the weed *Sonchus oleraceus* L. (Asteraceae)

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As a complement to traditional methods, analysis of the food web associated to target weed can be used for biological control purposes. Food web, also referred to as ecological network, define flow of matter and energy within a community. Description of trophic network provide a framework to understand species interactions and is expected to yield insights on several research questions: i) What is the composition of the natural enemies' community interacting with the target plant? ii) What is the specificity of those natural enemies for the target plant? iii) Is there a top-down regulation of potential biological control agents of the target weed by their own natural enemies (and thus what is their likely success of establishment)? iv) Are there differences in food web structure between the native and invasive range? Our analyses using such approach focus on the biological control of the sowthistle, *Sonchus oleraceus* L. (Asteraceae), which is native to Europe but invasive in Australia. This plant is a common agricultural weed in Europe, but in Australia, because of herbicide resistance and a lack of natural enemies, it is widespread and difficult to manage. CSIRO (Australia) has recently developed a collaborative research program with Montpellier SupAgro (France) for developing biological control solutions for this species in Australia. Besides traditional approaches (*i.e.* collection of natural

enemies in Europe and specificity tests), the project will also involve field surveys for this particular task. This will enable the establishment of a DNA barcoding reference database of the insect and plant communities associated with *S. oleraceus*. Traps permitting the capture of a large insect diversity will be used to ensure representativeness of the database. Second, the combination of innovative molecular approaches, namely metabarcoding and next-generation-sequencing (NGS), will allow constructing efficiently complex ecological networks. Metabarcoding refers to parallel detection of different taxon within a same sample (*e.i.* plants in herbivore gut-content or parasitoids in their host). This method relies on high-throughput NGS technologies to generate many DNA fragments simultaneously. Regular sample collections will be carried out from spring 2018 to autumn 2018 in Europe. In order to compare food webs structure from native and invasive area, the sampling in Australia will follow the same protocol. By developing this community approach, we expect to better optimize a sustainable management strategy of the weed.

Keywords: Biological control, sowthistle, natural enemies' community, trophic network, molecular approaches

Poster 7

Spatial distribution of *Oxalis pes-caprae* L. and its effect on flora diversity of olive groves in Crete, Greece

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It is well documented that the introduction of invasive plant species in a certain agro-ecosystem exerts significant impacts on flora diversity by modifying ecosystem processes and reducing the habitat size for native species. *Oxalis pes-caprae* L. establishment in the Mediterranean basin comprises a typical example of an invasion success story. It was introduced from South Africa approximately during the end of the 18th century and nowadays is considered a dominant weed species in the olive groves of Crete. The present study aimed at assessing the effect of *O. pes-caprae* invasion on flora diversity by using the four common diversity indices: Shannon's index, Simpson's index, evenness index and species richness. For that reason weed surveys of olive groves located in two study areas of Crete (Peza and Meramvello), were conducted over a 2-year period. The most frequently occurring weed species in both areas and observation years was *O. pes-caprae*, followed by *Bromus* spp. (Peza) and *Vicia* spp. (Meramvello). Although a greater number of species and a more equitable proportion of various species in the population increases the diversity measured by Shannon's and Simpson's indices, the first gives greater weight to rare species while the second index gives greater weight to common species. Both these indices exhibited a different trend between years. Shannon's index presented a

strong relationship with species richness, therefore the higher values of species richness in the second year caused a positive effect on Shannon's index. However, the magnitude of this effect was not consistent between the two study areas. It is also demonstrated that the increase of *O. pes-caprae* field density significantly decreases the diversity measured by Shannon's index, however with different intensity between locations.

Keywords: Weeds, biodiversity, Shannon's index, *Oxalis pes-caprae*, invasion, olive groves

Poster 8

The automatic mapping the weeded zones in the wheat crop

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With over 200 million ha cultivated area, wheat is one of the most important crops in the world. With all crops, and with wheat crop as well, one of main the problem are weeds. Research shows the yield losses caused by weeds can vary from 30% up to total compromise of the yield. The level of yield losses is correlated with the number of weeds and especially with the biomass level of the weeds. In this paper, we present an experimental set of tools for mapping weed areas in wheat fields. The research was conducted at The Romanian Plain at Experimental Farm of University “Moara Domneasca”. The equipment used consists of a two-wheeled, wheelbarrow-style mobile platform which is pushed by a person. The platform is equipped with the following equipment: an NDVI Infragram DIY Plant Analysis Webcam, a Raspberry Pi 3 Rev. 2 and a 16 GB microSD storage. To acquire the images at exact intervals, the platform is fitted with Hall-effect magnetic sensor “Brick SEN-MAG-03”. This sensor is mounted near of the of wheels, on which there are a number of magnets placed at equal distance from the center, and it sends a signal when one of those magnets gets in range and the sensor picks un the magnetic field. This results in an image covering roughly 1 m², and by taking 3 images per 2 m, we can use the overlap to stitch the images together without missing areas. The images are combined into one image using specialized orthophoto software. This image is then geo-referenced. To do this we place some landmarks on the field and measure them using a GPS TRK Trimble R4 with Juno 41. This geo-referenced orthophoto is the processed using the following methods and

formulas: First, we use a Python script to highlight the vegetation in the image. We use the Visible Vegetation Index, Vegetation areas are replaced over the original image with one single green color. We use the OpenCV library, specifically the *findContours* method to find contours around the green areas resulted from 1; the *houghLines* function to detect lines in an image. Those lines represent the rows in the fields. After some corrections to both (2) and (3), we assign the green contours from (2) which are outside the rows from (3) a weed coefficient, based on distance from the rows. We measured three areas of 5mx5m. For comparison, we also manually asserted the degree of weeding. In the end, our method resulted in 38,5% of the areas being weeds, compared to the manual method which resulted in 35, 9%. The difference between the two methods is not statistically assured. In conclusion, our method can be used with successfully in site specific weed management in precision spray only in weeded area.

Keywords: Weeds, wheat, automatic weed map

Poster 9

Evaluating the efficacy of 2,4-D+MCPA, sulfosulfuron, and lintur herbicides for controlling the invasive *Geranium dissectum*

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Cut-leaved Crane's-bill (*Geranium dissectum*) is an invasive weed which has infested canola fields of Mazandaran province, Iran, and has recently entered several fields of its neighboring province, Golestan. Due to the similarity in climate and vicinity of these provinces, this weed may also be able to invade the rest of the region. Three separate dose-response assays were conducted at the greenhouse of Gorgan University of Agricultural Sciences and Natural Resources in 2016 to investigate the efficacy of 2,4-D+MCPA, lintur and sulfosulfuron herbicides for controlling of this invasive weed. Eight seeds were placed in pots each serving as a replicate containing one kilogram of soil, with three replicates in total. At the three-to-four-leaf stage, 3 weeks after planting, the plants were sprayed with the commercial formulation of 2,4D+MCPA at 0, 0.0625, 0.125, 0.25, 0.5, 1 and 2-, and with commercial formulation of sulfosulfuron, and lintur at 0-, 0.1-, 0.2-, 0.4-, 0.8-, 1- and 2-fold the recommended field dose of the herbicides by using knapsack sprayer with a single flat-fan nozzle. The recommended field dose for 2,4D+MCPA, sulfosulfuron and lintur was 1360, 30 and 115 g a.i. ha⁻¹, respectively. Four weeks after spraying, the shoots were cut, placed in paper envelopes and kept in the oven for 48 hours at 70°C. The dry-weight data then were expressed as a percentage of the respective unsprayed control. A herbicide dose resulting in a 50% inhibition of weed growth (GR50) was estimated for each herbicide by using the obtained dose-response curves. The amount of GR50 for 2,4-D, sulfosulfuron and lintur was estimated 147.30, 28.07 and 150.01 g. ai. ha⁻¹, respectively, and the latter two were not statistically significant. GR90, the dose of herbicide that controls the weed as much as 90%, was estimated 560.47, >60 and >230 g. ai. ha⁻¹ for 2,4-D, sulfosulfuron and lintur, respectively. According to the results, *G. dissectum* was successfully controlled by 2,4-D+MCPA whereas lintur and sulfosulfuron failed in this regard. Results showed that applying 2,4-D+MCPA in wheat fields would be a successful way to control *G. dissectum* in canola-wheat rotation.

Keywords: Cut-leaved Crane's-bill, herbicide, invasive weed

Poster 10

Joint experiment by the EWRS Working Group Germination and Early Growth: Emergence and phenological development of *Avena fatua*

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Wild oats (*Avena fatua* L.) is a world-wide invasive species that competes strongly with small grain cereal crops, causing significant yield losses when left unmanaged. It is a summer annual weed in Northern Europe, while in Mediterranean climates it behaves as a winter annual weed. With a climate change this behaviour can change. A joint experiment with populations of *A. fatua* is being conducted to study the emergence and phenological development of this weed at several locations in Europe and the Middle East: Czech Republic, Denmark, Germany, Greece, Iran (2 sites), Latvia, Poland (3 sites), Spain and Turkey. Two common populations, the first one harvested in Latvia in a cereal field and the second one in Spain from road sides, were established in all locations plus one-three local populations at most sites. After more specific investigations the Spanish common population was *A. barbata*, a wild oat species which is more important in road-sides than in cereal fields. The seeds will be characterised regarding germination percentage at various controlled climatic conditions. The local populations were collected from surrounding crops in each site, most of them from cereal fields. Sowing was performed in 25 cm diameter pots in October 2016 by disturbing the upper 10 cm of the soil. 100 seeds were sown per pot, with five replications. The pots were buried in the soil. Samplings were/will be done every 2-3 days or weekly by destructive counts, from growing

season 2016/2017 and 2017/2108. Three plants per pot were assessed for phenological development according to BBCH-scale once or twice a week in the same period. Some key result on emergence percentages and rates will be presented, as well as phenological development focusing on certain growth stages (e.g. BBCH 14 -4 leaves on main shoot, BBCH 65- full flowering). Some experiences were that at southern latitudes *Avena* spp. emerged more in autumn or winter, while at the northern latitudes *Avena* spp. emerged more in spring or summer. The common population from Spain emerged in autumn/winter at more locations than the common population from Latvia. The percentage of emergence varied between locations. However, there was a trend that the common population from Latvia had a higher percentage of emergence at Northern latitudes (e.g. Latvia) compared to the common population from Spain, while at Southern latitudes (e.g. Spain, Iran, Turkey, South Poland) the common population from Spain had higher emergence than the common Latvian population. The local populations of *A. fatua* behaved more or less like the common Latvian common population with regard to magnitude and season of emergence. At southern latitudes (e.g. Spain, Iran) the Spanish population developed faster than the Latvian population. Preliminary results confirmed the summer and winter annual behaviour when growing at various latitudes. It also seems that the common populations are adapted to the origin and that the Latvian common population of *A. fatua* behave differently than the Spanish common population of the other species *A. barbata*. Data can be used to validate or re-calibrate already developed models for predicting emergence. The data can also make a basis for developing a model for predicting phenological stages in *Avena fatua*.

Keywords: biotype, climate change, habitat, temperature, soil moisture, wild oats

Acknowledgement: This study is a joint experiment conducted by the European Weed Research Society (EWRS) Working Group Germination and Early Growth. Full address list of participants can be given on request.

Poster 11

The effect of *Nerium oleander* extracts obtained by liquid nitrogen on germination and seedling development of *Avena* seeds

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Researches on use of allelopathy against weeds have increased. Most of these researches use plant water extracts in different ways, essential oils, or plant residues directly. In contrast, in this study we developed a novel method using liquid nitrogen to prepare powders of plant parts fast. Leaves of Oleander plants (*Nerium oleander*) which were collected during flowering period were powdered with the aid of liquid nitrogen. The powder was diluted into varying concentrations (1%, 2%, 4% and 8%) to test germination and seedling development (lengths of plumule and radicle) of two *Avena* species (*Avena fatua* and *Avena sterilis*) under 15°C in an incubator. The experiment was repeated twice. The effect of extract on germination was not significantly different for *A. fatua* but it was erratic on *A. sterilis*, which requires further experimentation to reach a conclusion. Lengths of both radicle and plumule of both species were significantly affected by all concentrations. The decrease in lengths was generally in parallel with increasing extract rates as expected. Using extracts of oliender plant gave promising results to control of *Avena* species. It is obvious that powdering plant with liquid nitrogen can be easier and more practical than other plant extract preparation methods.

Keywords: Allelopathy, *Avena fatua*, *Avena sterilis*, Oleander, liquid nitrogen

Poster 12

The effect of cultivar competitiveness and soil water availability on weed species composition in malt barley

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Although barley is characterized by a high allelopathic potential, weeds in some cases resist and become strong competitors which may lead to reduced yield and malt quality. The understanding of spatial dynamics of weed populations and the rate in which they spread within fields, especially under contrasting soil water availability, has an increasingly important impact on the methods used for the site-specific weed management in semiarid Mediterranean agroecosystems. A 2-year experiment was carried out in a typical Mediterranean environment of central southern Greece in order to: (i) explore the crop genetic variability concerning its suppressive ability and (ii) assess the effect of drought on weeds with continuous appearance or in patchiness. The experiment was carried out in Spata, Greece, at the experimental station of the Agricultural University of Athens. In each experimental year the field was divided in 48 sampling units of 1 m² and was free of any herbicide applications. The field margin was an uncultivated zone for a long time, occupied by weed populations of varied species in high densities. During each growing period records of the weeds' density and frequency were logged over the course of 15 days, for five months. Moreover meteorological data were taken into account such as total precipitation and mean temperature. The Inverse Distance Weighting

spatial interpolation method was applied and weed density maps for each sampling period for the three years were created. The weed density and spatial distribution varied widely among the different malt barley cultivars and water regimes. The most important weeds concerning their frequency and density were *Malva sylvestris*, *Sinapis arvensis*, *Chamomilla recutita*, *Cardaria draba*, *Gallium aparine*, *Silybum marianum*, *Calendula arvensis* and *Chrysanthemum coronarium* in the first year and *Avena sterilis*, *S. marianum*, *C. coronarium*, *C. drapa*, *C. recutita*, *M. sylvestris*, *S. arvensis* and *Papaver rhoeas* in the second year. The weeds' density maps were realized by spatial interpolation methods that determined the weed patchiness, providing the necessary data for a potential site-specific weed management.

Keywords: Greece, drought, weed patchiness, weed density

Poster 13

Effects of *Ailanthus altissima* (Mill.) swingle extracts on germination of some weeds and vegetable species

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Ailanthus altissima is an alien species which can invade disturbed habitats including croplands. The aim of this study was to find out possible effects of *A. altissima* on vegetables and some common vegetable weeds. Water extracts of dried and grinded parts (root, stem, leaf) of *A. altissima* were applied at various concentrations on seed germination of the weeds *Portulaca oleracea*, *Amaranthus retroflexus*, *Amaranthus hybridus*, *Echinochloa colonum*, and the crops tomato (*Lycopersicon lycopersicum*), lettuce (*Lactuca sativa*) and eggplant (*Solanum melongena*). In addition, leaf pieces extracts was tested. All extracts inhibited plants in varying degrees. In general, inhibition was higher by root extracts among all plant parts, similar by both leaf extracts, and higher by higher concentrations of any extract. Inhibition on *Amaranthus* species were less than 50%.

Keywords: Broomrape, chemical control, image analysis

Poster 14

Determination of weed species in sunflower (*Helianthus annuus* L.) fields in Ankara, Turkey

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A survey study was performed to determine weed species in sunflower cultivation areas in the Ankara province during 2014 and 2015. The fields allocated to sunflowers in Ankara have steadily declined over the last two decades, while the seed production obtained from the fields has remained approximately the same due to effective plant protection practices and cultivation of hybrids. Surveys were conducted during the growing period at 392 sunflower fields of the Ankara province by counting all weed species from 16 randomly selected 1/16-m² sample quadrats. A total of 30913 ha fields representing approximately half of the area under sunflower were surveyed in Bala, Gölbaşı, Haymana, Polatlı, and Şereflikoçhisar districts. Forty-eight weed species belonging to 23 families (one orobanchaceae, seven monocotyledonae, 15 dicotyledonae) were found in the surveyed fields. The families most commonly found were Asteraceae (eight species), Poaceae (seven species) and Fabaceae (three species). The most common weed species were *Acroptilon repens*, *Amaranthus retroflexus*, *Chenopodium album*, *Convolvulus arvensis*, *Orobanche ramosa*, *Sinapis arvensis*, and *Xanthium strumarium*, with 1.53, 2.56, 2.24, 1.76, 3.18, 4.32, and 5.65 weeds m⁻².

Keywords: Sunflower, weed, survey, frequency

Poster 15

Determination of morphological diversity of resistant and susceptible populations of *Anthemis arvensis* L. and *Matricaria chamomilla* L. to acetolactate synthase inhibitor herbicides

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Anthemis arvensis and *Matricaria chamomilla* are trouble weed species in the Mediterranean region and they are problems in many different cropping systems including winter cereals. The intensive use of herbicides has resulted in the evolution of herbicides-resistant weeds. This evolutionary process largely depends on the biology of the weed species, the biochemical properties of herbicides and management factors. Variation studies of plants are becoming increasingly common because reliable information are necessary to know populations dynamics, occurrence of herbicides resistance and demographic data. Resistant and susceptible populations of these species to Acetolactate synthase inhibitor herbicides was selected according to resulted TUBITAK (The Scientific and Technological Research Council of Turkey) Project. *Anthemis arvensis* and *M. chamomilla* populations were collected from totally 20 different locations that respectively had 2-3 resistant and 2-13 susceptible (from Marmara and Black Sea region) populations were compared with respect to morphological differences. The morphological characteristics measured included germination speed (day after sowing), flowering time (day), seeding time (day), number of branches (per plant), leaf area (cm²), plant height (cm), number of seeds (per plant), above-ground dry biomass (g), root dry weight (g), above-ground fresh biomass (g), and root fresh weight (g). The result showed that high morphological variability was found among resistant and susceptible *A. arvensis* and *M. chamomilla* biotypes and varied with similar geographic locations. Resistant and susceptible populations were distinguished clearly from each other. Morphological

variability among populations of these species would be influenced by agricultural practices, crop characteristics, geographic location and herbicide pressure.

Keywords: ALS inhibitor herbicides, *Anthemis arvensis*, *Matricaria chamomilla*, wheat, morphological diversity

*This study supported by TUBITAK (The Scientific and Technological Research Council of Turkey) (Project number: TOVAG 113O417)

Poster 16

Allelopathic Effects of *Cannabis sativa* L. extracts on *Ambrosia artemisiifolia* L. seed germination

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Due to the invasive and allergenic characteristics of *Ambrosia artemisiifolia* L., great efforts are being made in its suppression. The aim of this study was to determine the allelopathic influence of *Cannabis sativa* L. extracts on seed germination of *A. artemisiifolia*. Bio tests were conducted in laboratory during 2017. Ultrasonic extracts were obtained by extraction at 60°C and 30°C. The extracts were prepared using distillation residues at a concentration of 100, 50, 25 and 10% while the control was treated with distilled water. The fourth day after the setting of the trial, the average seedlings length (mm) was measured. All extract concentrations had inhibitory effect on seed germination. The seed germination decreased with increase of extract concentration. Germination rate of seeds treated with ultrasonic extract made on 60°C was 13% in Petri dish with concentration of 25% while in Petri dish with highest concentration of 100% the germination rate was 0%. Germination rate of seeds treated with ultrasonic extract made on 30°C was also inhibited in all applied concentration. Concentration of 100% showed the highest inhibitory effect on the seed germination (1%), while

the concentration of 10% showed lowest inhibitory effect on seed germination (35%). Due to the invasive nature of ragweed and its allergenic characteristics, numerous efforts are being made for its control. The results of this experiment indicate possibility of using the distillation residue of industrial hemp for the biological control of ragweed.

Keywords: *Cannabis sativa* L., *Ambrosia artemisiifolia* L., ultrasonic extract, allelopathy

Poster 17

Allelopathic effect of two alien and invasive *Chenopodiaceae* species on germination and growth of local plants

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One basic method of improving rangelands in the country is the use of native as well as exotic species of shrub. Some species of *Atriplex*, like *Atriplex canescens* and *Atriplex nummularia* has been introduced in many thousands hectares of rangelands since more than 20 years, it feeds some debates on the Algerian scientific community, so that's why it is important to know the impact and necessary to consider its effects on native species. In the current study the effect of chemical competition of *Atriplex canescens* and *Atriplex nummularia* comparing to native *Atriplex halimus* by observing the effect of aqueous extracts of shoot and roots of the three chenopod species assayed at different concentrations on the germination of a local plant *Lygeum spartum*. Seed germination was significantly inhibited by shoot and root alien species extracts especially *A. nummularia* with decrease rate of 80% indicating the presence of allelopathic substances, *A. canescens* shows an inhibitory effect more efficient with solution of shoot extract. The introduced *Atriplex* species have an allelopathic effect, inducing a physiological and a ecological mechanism that controls the time and rate of Germination and growth of young plants from these results we can conclude that the effect of the introduced *Atriplex* could be dangerous to the long-term development of local plant species. The species of *Atriplex* introduced are distinguished by a very invasive character able to modify and eliminate the natural floristic procession of the space where it is introduced in view of its potential for biomass production, height, its covering and its allelopathic power.

Keywords: *Atriplex halimus*, *Atriplex canescens*, *Atriplex nummularia*, allelopathy, germination, invasive, rangeland

Poster 18

Sonchus oleraceus natural enemy community update and biological control perspectives

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Sowthistle, *Sonchus oleraceus* L. (Asteraceae), is a widespread agricultural and garden weed in its native range of Europe. In Australia, this invasive weed has developed herbicide resistance and is now extremely difficult to manage with currently available methods. CSIRO is working in collaboration with Montpellier SupAgro (France) initiating a classical biological control program for this weed. The first phase of the program includes native range surveys for characterizing the natural enemy community (arthropods and fungi) associated with *S. oleraceus*. Under this phase, seven western countries of Europe and Morocco have been surveyed to date. Leaves, flower buds and flower heads were collected. Stems and roots were dissected and inspected for the presence of feeding insects. Insects are being maintained in rearing conditions at the CSIRO European Laboratory (France). Identifications are underway. So far, Diptera is the best represented order with early potential biocontrol agents found being the leaf-gall former, *Cystiphora sonchi* (Vallot) (Cecidomyiidae) and the bud-gall former, *Tephritis formosa* Loew (Tephritidae). To select suitable biocontrol agent(s), host specificity and efficacy of the different candidates will be assessed following the standard classical biological control approach. In addition to identifying potential biocontrol agent(s), this work will characterize

the natural enemy community on *S. oleraceus*, which is surprisingly poorly understood across its native range. This work will provide the basis for ecological studies of this community study, currently developed as a complementary approach to design a sustainable management strategy of the weed.

Keywords: Biological control, wothistle, natural enemies' community, arthropods, fungi

Poster 19

Galium aparine germination under different temperatures

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Cleavers (*Galium aparine* L.) are among the most dense and common broadleaf weeds in wheat fields in the Sakarya Province of Turkey. Producers have complained that the control of cleavers with chemicals has not been as good as it had been before. A study was initiated to find out reasons of control failures and alternatives of current techniques including germination and biology of clavers and test of herbicides for resistance. This paper covers germination studies of which outcome might be used during all other studies in the project and to develop integrated control methods. Germination of a claver population from the Sakarya Province tested in petri dish experiment under four constant temperatures 4, 10, 15, 20 °C. Germination rates at 30th days were 83% at 4 °C, 93% at 10 °C, 53% at 15° C while there was no germination occurred at 20 °C.

Keywords: Cleavers, germination, temperature

List of Attendees

Agnieszka Synowiec	Poland
Ahmet Tansel Serim	Turkey
Ahmet Uludağ	Turkey
Aleksandra.M.Savic	Serbia
Alexander Menegat	Sweden
Arslan Masood Peerzada	Australia
Alexandros Assariotakis	Greece
Chloe MacLaren	United Kingdom
Christian Bohren	Switzerland
Deniz İnci	Turkey
Duygu Şişek	Turkey
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Jevgenija Necajeva	Latvia
Jordi Recasens	Spain
Josef Holec	Czech Republic
Katharina Dehnen-Schmutz	United Kingdom
Kirsten Torresen	Norway
Kostas Karakitsos	Greece
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Melodie Ollivier	France
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Heinz Müller-Schaerer	Switzerland
Natasa Samardzic	Serbia
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Nurcan Büyükkurt	Turkey
Petros Vahamidis	Greece
Garyfalia Economou	Greece
Rita Filep	Hungary
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Sandra Citterio	Italy

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Alireza Taab
Vaya Kati
Vincent Lesieur
Yan Sun
Sadiye Zambak
Bouchikh Yamina
C.N. Giannopolitis
Gkolemis Marios
Sava Vrbničanin
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