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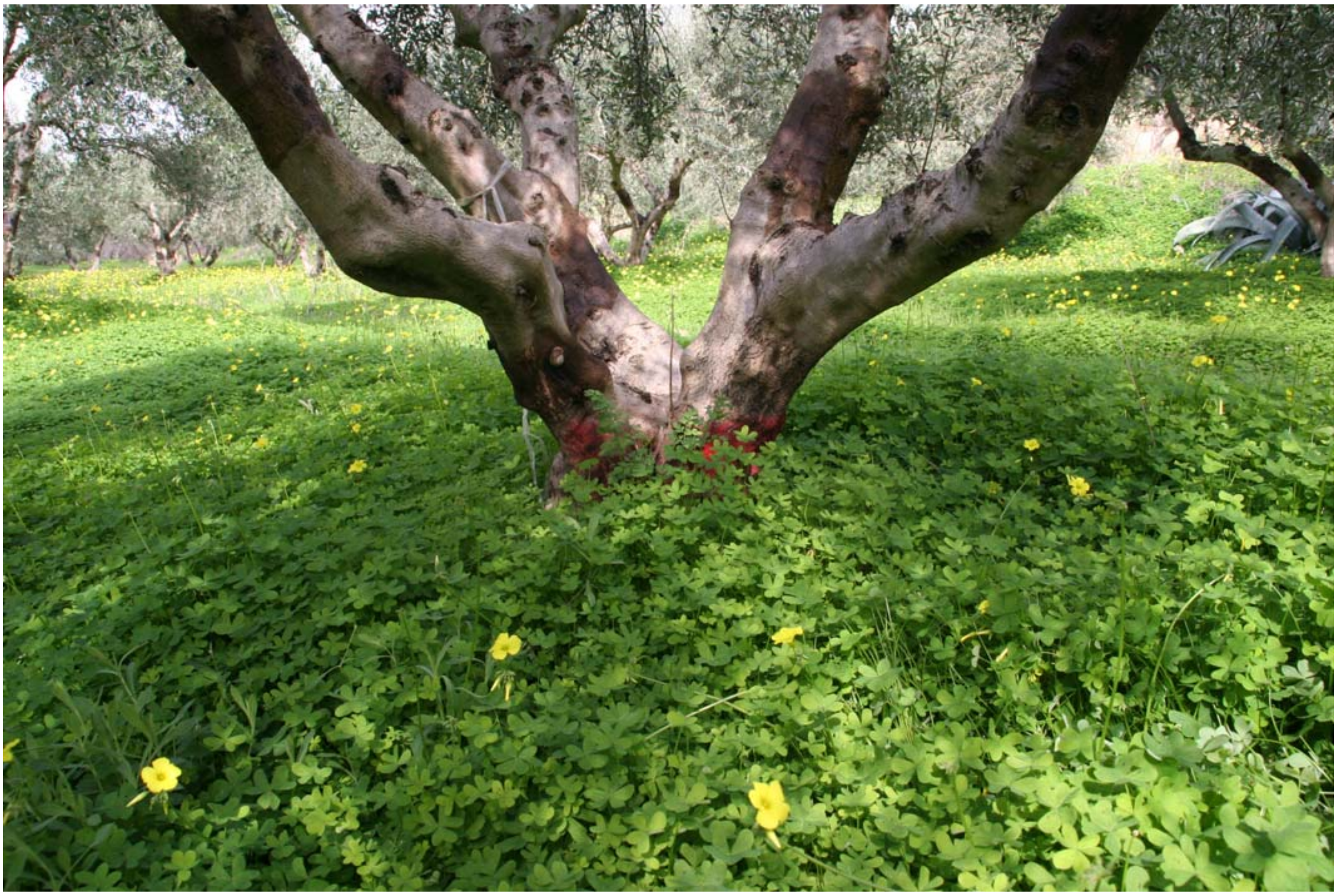

Oxalis pes-caprae L. dominating the understory vegetation in an organic olive grove in the Greek island of Crete (3 February 2013) (Picture and text: Paolo Bàrberi; see p.5 for more).

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INSTRUCTIONS FOR CONTRIBUTORS

Deadline for contributions to be published in the following Newsletter issue:
1 July 2013

Photographic images

It is possible to include photographic material. Please make sure that the images are taken at no less than 300 dpi otherwise the picture quality drops.

Questions

If you have any problems in writing or formatting your article, please do not hesitate to contact me. I'll be happy to assist you. As Technical Editor of the Newsletter, I prepare the final layout of the Newsletter prior to publishing. You can contact me by sending an E-mail to **newsletter@ewrs.org** / **moonen@sssup.it** or by calling me at +39 050 883567. I'm looking forward to receiving your contributions.

CHARGES FOR JOB ADVERTISING IN THE NEWSLETTER

- Job advertisements are free of charge for EWRS members from public research and education institutions.
- The rate for a job advertisement from private enterprises is € 100,00 page. Reductions can be negotiated with the Newsletter editor for half page adverts.
- Publication of a job advertisement on a special page of the EWRS website **http:\\www.ewrs.org** will be charged € 300,00 per advert.

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FROM THE BOARD

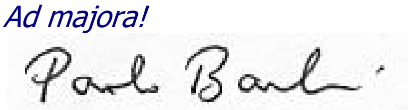
PRESIDENT'S MESSAGE

In less than two months we will be meeting in Samsun for our 16th Symposium. The scientific programme has nearly been finalised and, as usual, it is exciting. Over the last months, the EWRS Scientific Committee has worked hard in close contact with the local organizing committee to shape up an intriguing event. The symposium eve (Sunday 23 June) will line up two workshops organised by the Working Group 'Education and Training': one on 'How to write a paper for a scientific journal' and one on 'High-quality photography for agricultural and weed science'. Sunday will also see dedicated workshops organised by other Working Groups. Seven scientific sessions with invited, platform and poster presentations will be the core of the symposium: Weed Biology, Weed Ecology I, Weed Ecology II, Non-chemical Weed Control, Optimization of Chemical Weed Control, Causes and Management of Herbicide resistance, Options and Perspectives in Weed Management. Stay tuned to **www.ewrs2013.org** for the latest updates and details on the scientific programme. If you have not done it yet, remember to register through the symposium website. I look forward to meeting you in Samsun!

In early autumn, the CIHEAM's Mediterranean Agronomic Institute of Chania (Greece) will host a joint Workshop of the EWRS Working Groups 'Novel and Sustainable Weed Management in Arid and Semi-Arid Agro-Ecosystems' and 'Weed Mapping'. The Workshop is scheduled from 29 September to 3 October 2013. The first circular can be downloaded from the EWRS website at: **www.ewrs.org/coming_events.asp**. You can register online at: **http://confer.maich.gr/registrations/weed_2013**. Remember that, as usual, the EWRS will subsidise part of the expenses of junior scientists submitting an oral or poster paper. Details on when and how to apply for these subsidies can be found on the Conference and EWRS websites. Chania is a lovely port city in North-Western Crete with several testimonies of the Venetian and Ottoman heritage. Don't miss the opportunity to freshen up your weedy knowledge and prolong your summer in an exciting environment! Also, remember to visit **www.ewrs.org** regularly to get the latest news on all workshops organised by our Working Groups.

Regarding Working Groups, as you know they are the heartbeat of our Society. It is my pleasure to anticipate that EWRS Working Groups are engaged in writing a book on 'Expanding Horizons in Weed Research' (provisional title), which will be published by Wiley-Blackwell and edited by Paul Hatcher (Chairman of *Weed Research* Editorial Board) and Bob Froud-Williams (former EWRS President). The book is targeted to final year undergraduates, MSc and PhD students, academics and practitioners looking for a synthesis and update on current weed research issues. The rationale for producing this book is that whilst there are several weed biology and control textbooks, many excellent review articles in the area, and some good practical guides to weed control, there is no up-to-date one volume guide to the current state of weed research, and its future prospects. We expect that that this book will bridge this gap. To meet such an ambitious goal, there was no better way than involving our Working Groups, which are a unique forum of high-level experts on the main areas of research and application in weed biology, ecology and management. We expect the book to be finalised next autumn and to be launched on the global market shortly afterwards. Take note because this is going to be a 'must read' piece of scientific literature which should take a place of honour on your bookshelf!

Ad majora!



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SCIENTIFIC COMMITTEE AND WORKING GROUPS

WORKING GROUP PARASITIC WEEDS

Maurizio Vurro, Coordinator Working Group Parasitic Weeds; **maurizio.vurro@ispa.cnr.it**

STREAM - Strigolactones: biological roles and applications: a new European Network within the COST framework: COST Action FA1206.

Strigolactones (SLs) are a class of structurally related carotenoid-derived compounds with multiple functions in plant physiology and plant-biotic interactions. They are produced in all plants examined so far, including eudicot, monocot and primitive plants. SLs are produced mainly in plant roots and are secreted to the soil, thus present in the rhizosphere. Their benefit to agriculture may be derived from their association both with beneficial and detrimental plant biotic interactions, and their function as plant hormones that regulate both shoot and root development. The consortium will form a network of collaborations that will facilitate finding SLs-related alternatives for field use. SLs were first identified as root-exuded host factors that stimulate the germination of the seeds of parasitic plants (e.g.: *Orobanche*, *Phelipanche* and *Striga* spp.).

Parasitic "witchweeds" and "broomrapes" are causing massive damage to cereal, legumes, solanaceous crops, sunflower and many other crop production in the Mediterranean area and in the developing world; overall they are among the most destructive weeds in agriculture around the world. They represent a serious risk for food security, because they substantially reduce yield, and may lead in some of the regions to increase poverty and hunger. This threat led the UN to state that *Striga* infection alone is the largest impediment to poverty alleviation in Africa and the Gates Foundation to support a *Striga* control project in 2011. Moreover, weed management of parasitic plants is extremely difficult. This is because almost all the traditional methods of control were proven to be scarcely effective. A better knowledge on their mode of action may lead to development of ways to block the SLs-related seed germination signal, and thus to prevent parasitic weed seed germination. SLs act also in the rhizosphere as signalling molecules in the interaction with beneficial arbuscular-mycorrhizal fungi (AMF) and nitrogen-fixing bacteria of the genus Rhizobium, facilitating the establishment of these symbioses.

In agricultural systems, SLs may be used for promoting these beneficial associations. For that purpose, a structure-activity relationship allowing to reduce the molecular complexity to minimum structures while maintaining the essential functionalities and bioproperties is desidered. The design and synthesis of analogues of SLs that are more potent or have longer sustainability in the soil is strongly needed. These may be used to specifically promote these beneficial symbioses in agricultural systems. An additional agriculturally relevant aspect of SLs is related to nutrition balance. Since SLs are promoted under nutrient limiting conditions (mainly phosphorus and nitrogen), they are proposed to play a key role in the regulatory network for adaptation of shoot and root architecture to poor mineral nutrient supply, including the fostering of rhizosphere associations for added nutrient acquisition. An example for the usage of SLs in this regards is development of biotechnological means for treating plants in the field with SLs, with the aim of regulation of their shoot and root development. This will reduce the need for development of genetically modified crops, and may promote sustainable solutions to nutrient poor environments.

To conclude, a more comprehensive and coordinated knowledge on SLs, will facilitate the possibilities of implementing SLs usage in sustainable agriculture. In this sense a coordinated research on SLs, termed STRigolactones Enhanced Agricultural Methodologies (STREAM) consortium, in the frame of the COST program will provide a unique opportunity to create a forum for meetings and discussions on the concepts and understanding of SLs, as well as their potential use in agriculture for a variety of plant species and crops in Europe, but also in developing countries. Thanks to the flexibility of the COST Action tool, other scientists from non-EU countries could be involved in the scientific advances. Also, the network might be joined by people that have never worked directly on SLs, but their expertise could be very useful for opening new research frontiers: e.g. experts in parasitic weed managements and parasite biology, plant-microbe interactions, chemistry, bioinformatics, etc. Likewise, scientists from the industry may join the action: their integration will promote further collaborations financed by EU Framework Program and other European organizations, both as basic and applied research as well as the opportunity to jointly develop new means for efficient and specific application of SLs for agricultural usage. As this is a coordinating network, it will foster collaboration rather than internal competition, avoid redundancies in research efforts, and allow the emergence of synergies in this highly competitive field of research. In later stages this network might lead to discover innovative research areas and to the ability to submit joint proposals for EU research funds (e.g., the EU Framework Program).

The Network is chaired by Prof. Cristina Prandi (Department of Chemistry, University of Turin, Torino, Italy) and vice-chaired by Dr. Hinanit Koltai (Volcani Center, Faculty of Plant Sciences, Bet Dagan, Israel), and currently counts 20 signatory Countries. It was officially approved in November 2012 and had the kickoff meeting in Bruxelles on April 12. Further information can be found on the COST website at **http://www.cost.eu/domains_actions/fa/Actions/FA1206** and on the website of the action when available.

Good possibilities of collaboration of participants are foreseen between the action and the EWRS Working Group "Parasitic Weeds", also considering that one of the Working Group to be established within the Action regards parasitic plants.

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MEMBER CONTRIBUTIONS

INVASIVE WEEDS: *OXALIS PES-CAPRAE*

By Paolo Bàrberi: EWRS President; **barberi@sssup.it**.

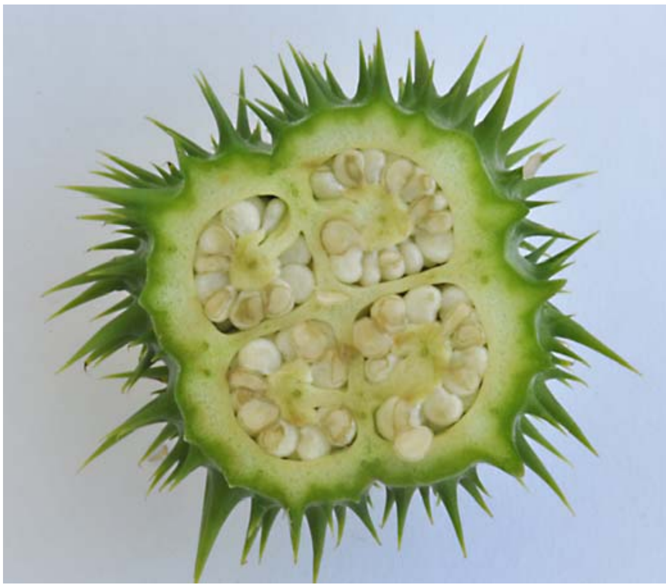
Oxalis pes-caprae (Oxalidaceae) is considered one of the 10 worst invasive plant species in Europe (McLaughlan *et al.*, in press). It often dominates the landscape in Mediterranean perennial agroecosystems like olive and citrus groves and vineyards. It is a stemless geophyte reproducing by rhyzomes and 5 - 8 mm bulbils. It has bright yellow flowers and blooms between November and May. The fruit is a capsule which, however, rarely reaches maturity. Thanks to its stationary and creeping underground propagules, *O. pes-caprae* can quickly colonise disturbed soil, easily displacing native vegetation of conservation interest through competitive exclusion. In olive, it can make hand-picking of olives from the ground difficult. In *O. pes-caprae*-invaded agroecosystems, net primary production is reduced due to the lower biomass production and faster decomposition rate compared to native plants. This is likely to negatively affect carbon cycling. Much of its European range is valuable for rare flora and spread of this species threatens ecotourism value of these regions (particularly Mediterranean old fields). However, *O. pes-caprae* can also have positive effects, providing forage to honey bees and preventing the establishment of other weeds, leaving soil bare by summer. Mechanical control is not an option because of the regeneration strategy of this species, but competitive cover crops (e.g. *Vicia* spp.) can substantially reduce *O. pes-caprae* abundance. Chemical control can be done e.g. with metsulfuron-methyl or glyphosate, with best results if applied at flowering, when photosynthates accumulated in bulbs are at minimum and bulbils are not yet formed.

Mclaughlan C, Gallardo B & Aldridge DC (in press) How complete is our knowledge of the ecosystem services impacts of Europe's top 10 invasive species? Acta Oecologica, **http://dx.doi.org/10.1016/j.actao.2013.03.005**

THE HISTOLOGY OF *DATURA STRAMONIUM*

Dear Colleagues,

My short histology note of this Newsletter is devoted to *Datura stramonium* L. (Bayer code: DATST) or Jimson weed. It is a typical member of the Solanaceae family. This means it produces toxic alkaloids. All plant parts contain the tropane alkaloids atropine, hyoscyamine and scopolamine. A transverse section through leaves, petioles and the stem reveal bicollateral vascular bundles. The spectacular fruits are spined capsules which split into four chambers. *D. stramonium* is native to North America. Today, it can be found all over the globe where it prefers warm or moderate habitats. In Germany, it grows along field margins, sometimes in sugar beet fields and from time to time in ornamental fields.



Transverse section of a capsule showing the four seed chambers.

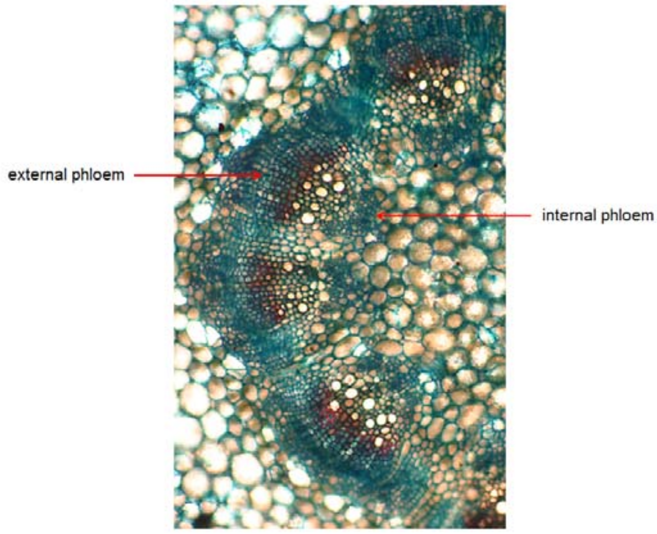
D. stramonium at the border of a wheat *field* near Frankfurt, Germany.

Ripe, opening fruit

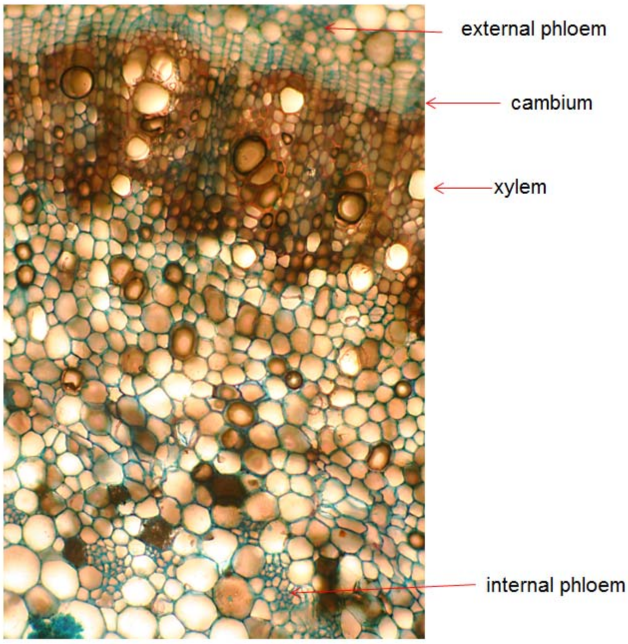
Fruits and flowers of *D. Stramonium.*

Seeds arranged along placenta (arrow)

Roots are tap roots very similar to those of tomatoes.



Transverse section through peduncle of *D. stramonium* with bicollateral vascular bundles ; 100x



Transverse section through stem of *D. stramonium* ; 400x

H. Krähmer

REVIEWS

PHD THESIS (1)

Spatially-explicit modelling of weed population dynamics for integrated weed management at different spatial scales

Lucía González-Díaz; Institute for Sustainable Agriculture (CSIC), Córdoba, Spain; g92godil@ias.csic.es
Supervisors: Dr. José Luis González-Andújar and Dr. Antonio J. Pujadas-Salvà

Avena sterilis L. (wild oat) and *Lolium rigidum* Gaudin (ryegrass) are the dominant species in Spanish dryland cereals. They compete with the crop resulting in decreased crop yields. The control of those weeds rely on herbicide applications, implying important environmental and herbicide-resistance problems. The adoption of new management strategies to diversify the weed control, hence to reduce the risk related to the reiterated herbicide applications, are desirable measures but those new strategies imply long-term experimentation with high economic cost and time consumption. As an alternative to the long-term field experiments, models of weed population dynamics present the opportunity to explore and compare long-term management strategies for weed control in a short period of time.

To date, most weed population models focus on temporal evolution ignoring the spatial framework. In this context, three spatially explicit models about *A. sterilis* and *L. rigidum* have been developed at different spatial scales (i.e., one at field scale and the others at landscape scale). These models were used to achieve effective and profitable management strategies with a low risk for the evolution and spread of resistance.

The first model was developed at field scale to compare chemical and cultural management strategies on the control of *L. rigidum* populations in cereals. The model was partially validated with independent experimental data; the weed growth rate distributions of the observed and simulated plots were similar. The best management strategies were the integrated management programs implying cultural methods and herbicide applications at a full rate. Half-rate herbicide applications and cultural control methods were less profitable on the *L. rigidum* control although occasionally half-rate herbicide applications were more profitable than full-rate herbicide applications. The economic returns were negative in all management strategies simulated. It evidences the need to apply management strategies based on low inputs to increase the profitability of Spanish cereals. *Lolium rigidum* seed bank and the economic returns were more sensitive to the fecundity and the weed control rate exerted by each management strategy than to other factors included in the model.

The second model was developed at landscape scale to study both short- and long-term *A. sterilis* population dynamics under different management scenarios based on two and three crop species rotations. How seed dispersal affects the interactions between crop rotation and landscape heterogeneity schemes with regards to weed control were assessed. Crop rotation had great potential to control *A. sterilis* populations, whereby both the number of crop species and the cropping sequence within the crop rotation had significant effects on weed population densities. Weed seed densities increased in landscapes with increasing similarity in crop proportions, but in these landscapes the level of seed dispersal affected which three crop species rotation sequence was most efficient at controlling the weed densities. Homogeneous crop field patches that follow a specific crop rotation sequence might be the most sustainable methods of weed control. Two practical approaches might be derived according to those results: the first one is that cleaning procedures of the tillage and the harvesting equipment would reduce the weed seed dispersal rates between fields and hence the weed population at the landscape level, and the second one is that an effective weed control through crop rotation requires coordination between farmers with regards to cropping sequences, crop allocation across the landscape and/or the fraction of each crop across the landscape.

The third model was developed at landscape scale to evaluate the efficacy of some management strategies slowing and decreasing the herbicide-resistance evolution and spread in *L. rigidum* populations. The model predicted herbicide-resistant weed populations at the landscape level beyond three years whereby equal herbicide modes of action was applied every year. Cropping systems based on cereal monoculture developed herbicide resistance before other crop rotations (i. e., cereal-sunflower). Management strategies such as the use of crop rotations and/or rotation of different herbicide modes of action, were more efficient decreasing the resistance evolution in landscapes with established herbicide-resistant weed individuals than strategies based on decreasing the weed seed dispersal between fields. The pollen flow was the dispersal vector which mainly drove the resistance spread over the landscape. The pollen movement in conjunction with the seed dispersal, due to the sowing of weed-contaminated cereal seeds and the harvester movement over the landscape, produced a positive synergistic effect in the spread of herbicide-resistant *L. rigidum* populations. The sowing of certified or cleaned crop seeds and a less randomised movement of the harvester at harvest timing collaborated on slowing the resistance spread over the landscape.

The models developed along this thesis are original approaches in weed science based on new concepts and tools. The present work improves the knowledge about weed population dynamics at different spatial scales and how important the economic analysis and the spatial framework are in the study of the weed management strategies. An effective weed control would require a combination of management approaches at different spatial levels.

Publications:

González-Díaz, L.; van den Berg, F.; van den Bosch, F.; González-Andújar, J. L. (2012) Controlling annual weeds in cereals by deploying crop rotation at the landscape scale: *Avena sterilis* as an example. Ecological Applications 22, 982-992.

PhD Thesis (2)

Distribution, Identification and Diversity of *Orobanche* spp. populations in Greece

Dionyssia Lyra; Agricultural University of Athens, Faculty of Crop Science.

Orobanche spp. parasitize a considerable number of economically important crops such as tobacco, tomato, sunflower, legumes etc. in Greece. All *Orobanche* spp. are characterized as holoparasites, since they totally depend on their plant hosts for their survival and development.

65 broomrape populations were collected throughout Greece parasitizing tobacco, tomato, faba bean, carrot and pea crops, with the aim to study the extent of morphological, genetic, physiological variability. Spatial heterogeneity was also studied for the sampling regions. 17 morphological characteristics were studied for the identification of collected broomrape samples, according to Flora Europaea and Flora d' Italia taxonomic keys. The identified species were: *O. aegyptiaca*, *O. ramosa* and *O. crenata*. However, some broomrape samples were characterized as intermediate forms of *O. aegyptiaca* and *O. ramosa* and named as '*O. ?*' biotypes. Analysis of variance for morphological characteristics showed that *Orobanche* spp. differentiated even among and within surveyed areas. In all multivariate analyses conducted, broomrape populations were clearly distinct on the basis of flower morphological characteristics, while '*O. ?*' biotypes were grouped between *O. aegyptiaca* and *O. ramosa* samples.

Orobanche ramosa in tobacco crop.

RAPD molecular markers were used for the study of genetic variability of *Orobanche* samples. Molecular analyses showed that *O. aegyptiaca* populations were characterized by higher differentiation compared to *O. ramosa* ones. In addition, high within population variability was observed for *O. crenata* samples. It seems for '*O. ?*' biotypes that they are interspecific hybrids between *O. aegyptiaca* and *O. ramosa* species and they are possibly products of continuous back-crosses. Host-plant seems to influence more the genetic variability for *O. crenata* , whereas geographical distance seems to have more impact on the other species.

Physiological variability for *Orobanche* populations was investigated with germination and parasitism studies. Algit Super®, an aqueous solution of the algae *Ascophyllum nodosum*, and GR_{24}, a stimulant-control, were evaluated for their efficacy to induce *O. aegyptiaca*, *O. ramosa* and *O. crenata* seeds' germination at 18, 20 and 23°C. In most cases, *Orobanche* seeds responded in a greater extent to GR_{24} compared to Algit Super®. However, *O. aegyptiaca* and *O. ramosa* seeds responded much better to Algit Super® compared to *O. crenata* which germination was very low. On the contrary, the radicle of all broomrape species was longer after Algit Super® application compared to GR_{24}. In addition, high variability was observed between and within *Orobanche* species.

Moreover, *Orobanche* populations were studied for their efficacy to germinate and parasitize host-plant seedlings in vivo with plastic bag assays. Tomato and tobacco were the host-plants used for *O. aegyptiaca* and O. ramosa and faba bean was used for *O. crenata*. *Orobranche ramosa* seeds germinated more compared to *O. aegyptiaca* seeds. The number of tubercles developed on the root system of tobacco and tomato was approximately the same for *O. aegyptiaca*, but *O. ramosa* formed more tubercles on tomato roots. *O. crenata* seeds did not develop any tubercle on faba bean roots. High interspecific variability was observed among all *Orobanche* populations.

The distribution and the infestation level of all *Orobanche* species for all infested crops in all surveyed regions were also studied. Global Position System (GPS) and Geographical Information System (GIS) were utilized in order to map these two parameters. Mapping gave a clear image of the variation in the infestation level among species and sampling areas. Furthermore, several soil and bioclimatic parameters of spatial heterogeneity were taken into account for the regions under study: soil structure, pH, organic matter, annual humidity index and degreedays for the whole biological cycle of cultivated crops. Statistical analyses, which were conducted to trace any correlation between the aforementioned parameters and the level of infestation provoked by *O. aegyptiaca* and *O. ramosa*, showed that it was negatively correlated with pH, annual humidity index and positively with organic matter. As far as *O. crenata* is concerned, no correlation was observed.

MSc Thesis (1)

Multiple Herbicide Resistance in *Conyza* spp. populations: Distribution and Mechanisms.

Tzipora Whitefish Lazar, Faculty of Agriculture, Food and Environment, The Hebrew University of Jerusalem, Rehovot 76100, Israel. Supervisor: Baruch Rubin.

In Israel, three *Conyza* species can be found: *Conyza bonariensis* and *C. canadensis* and *C. albida*. The first two species are troublesome in various habitats like vineyards, orchards, nurseries, field crops and roadsides. The weeds spread quickly, due to their fecundity and the fact that seeds easily dispersed by wind. The aim of this study was to survey the distribution of resistance across the country and to characterize the molecular aspects involved in this resistance. Mapping the distribution has shown that *Conyza* spp. distribution is anthropogenic and independent of soil type, crop or climatic conditions.

Seeds of *C. bonariensis* and *C. canadensis* populations were collected from roadsides and orchards and fields throughout Israel form nearly 100 sites and tested for their response to herbicides. Seeds were germinated under controlled conditions and the seedlings were transferred to pots filled with a potting mix. Herbicides were applied post-emergence to plants at the rosette stage (5 to 7 leaves). Tested herbicides were three ALS inhibitors: imidazolinone (IMI) - imazapyr ('Arsenal', 240 g imazapyr L^{-1}); sulfonylurea (SU) - sulfometuron ('Oust', 75% sulfometuron); and pyrimidinylthiobenzoate (PT) - pyrithiobac ('Staple', 850 g pyrithiobac-sodium kg^{-1}); a PSII inhibitor - atrazine ('Atranex', 800 g atrazine L^{-1}) and glyphosate ('Roundup', 360 g ae glyphosate L^{-1}). Dose response curves were plotted and the ED50 (herbicide rate that cause 50% inhibition of shoot fresh weight) values were extracted. Based on the ED50 values we concluded that the majority of the populations of *C. bonariensis* were ALS-sensitive whereas 5 *C. canadensis* populations were identified as highly resistant to ALS inhibitors. Those populations (5a, 6a, 10a, 17a, 21a) were also tested for resistance to PSII inhibitors. In order to find out whether alteration(s) have occurred in the target gene, DNA was extracted from each individual plant and specific primers were prepared. Regions identified in the literature as containing mutations were amplified using PCR and sequenced to locate the mutations that code for the alterations. We were able to distinguish between three types of resistant populations: (i) cross-resistance to SU, PT and IMI herbicides, as observed in populations 17a and 21a (*Trp*574 to *Leu*). (ii) a high level of SU resistance and IMI sensitivity, as in population 6a (substitution of *Pro*197 to *Ser*); and (iii) IMI resistance and SU sensitivity, as observed in population 10a (substitution of *Val*205 to *Ala*). We also found another population (5a) in which less than half of the individuals were resistant conferring a *Trp*574 to *Leu* mutation endowing the plants resistance to all three groups of ALS inhibitors, however, high level of variability was observed between individual plants; only 40% of the individuals were resistant. Of those resistant individuals, 30% were homozygous for the mutation and 10% were heterozygous indicating that 5a is a population in transition. In addition populations 17a and 21a, exhibited also high resistance to atrazine due to a substitution of Gly264 to Ser endowing a multiple resistance to other PSII-inhibiting herbicides.

Glyphosate resistance was identified in *C. bonariensis* population 46b, but as expected, the level of this resistance was low, not more than 5-15 fold as compared to the sensitive populations. Extraction and sequencing of DNA revealed no mutations at the target site. This finding may indicate that the observed glyphosate resistance is based on mechanisms that are unrelated to the target gene, such as enhanced detoxification or sequestration of the active material due to an impaired translocation of the active material. As shown in this study, herbicide resistance has evolved in *Conyza* spp. in Israel to a wide range of herbicides due to a misuse of herbicides. The resistance mechanisms identified in this study render quite a large variety of cross- and multiple-resistances to the tested *Conyza* populations making the development of a rational and practical control program – impossible. In addition, the fecundity of *Conyza* species, combined with the fact that they emerge in a number of waves during the growing season, have helped these weeds to successfully compete with the local vegetation and field crops. This problem, which threatens Israeli agriculture, is not expected to be solved in the near future, as the seeds of resistant plants can also reach fields that have never been exposed to these herbicides. This underlines the importance of continued research in this area, in order to encourage adoption of integrated management practices, both cultural and chemical, to prevent further dispersal of the resistance traits to other fields.

MSc Thesis (2)

Development of a decision support system (DSS) for Egyptian broomrape (*Phelipanche aegyptiaca*) management in carrot (*Daucus carota* L.)

Amnon Cochavi, Faculty of Agriculture, Food and Environment, The Hebrew University of Jerusalem, Rehovot 76100, Israel. Supervisors: Hanan Eizenberg and Baruch Rubin.

Egyptian broomrape (*P. aegyptiaca*) and crenate broomrape (*Orobanche crenata*) are a severe threat to agriculture in the Mediterranean area in many crops and vegetables. Carrot is sown in mid-July, and harvested in the late spring of the next year. Depending on the level of infestation, the potential damage of broomrapes in heavily infested fields may reduce carrot quality and yields, sometimes up to total yield loss. As a root parasite that can effectively controlled only in the soil subsurface, the prediction of the parasitism dynamics in this phase is a key factor in the development of a smart decision support system (DSS) for a rational chemical control of *P. aegyptiaca* in carrot.

The main objective of this study was to develop a DSS for a rational broomrape management in carrot. The sub-objectives are: a) to develop a robust predicting model for the parasitism dynamics in the soil sub-surface growth stages; b) to optimize a broomrape control program based on the parasitism dynamics model; c) to integrate parasitism dynamics models and chemical control approaches into a robust DSS for a rational broomrape management.

Fifteen field experiments were conducted in commercial carrot fields throughout Israel between 2010 and 2012, under various geographical and climatic conditions. The experiments employed a minirhyzotron camera, which allows non-destructive in-situ subsurface observations of parasite development. At each location, four transparent tubes artificially inoculated with *P. aegyptiaca* seeds, were buried in soil. Observations for carrot root growth and *P. aegyptiaca* development were conducted once a week throughout the growing season. Soil surface temperature (top 10 cm) was recorded, and the measured temperature units were converted to thermal-time using several mathematical equations that included among other linear equation, parabolic equation or β-function. The latter function takes into consideration that parasitism dynamics in supra-optimal temperature ranges which in our case is completely inhibited and therefore the computed contribution of temperature to the parasitism dynamics is zero. Several models were tested for best predicting the parasitism dynamics and the specific parasitism stage of 1-2 mm size of broomrape attachments using appropriated statistical analysis. Fit of equations was evaluated by ANOVA of the regressions and root mean-square error (RMSE). Another set of experiments that were conducted under field and controlled conditions examined the broomrape control efficacy and the selectivity of carrots to glyphosate ('Roundup', 0.36 kg ae glyphosate L^{-1}), imazapic ('Cadre', 240 g ai imazapic L^{-1}) and imazamox ('Pulsar', 40 g ai imazamox L^{-1}) applied postemergence.

The results indicate that temperature has the major effect on broomrape parasitism in carrot. The greatest parasitism rate was observed when carrot was grown under 28-22°C (D/N) temperature regime. The fact that temperature has a great impact on host-parasite relationship was used to develop a predicting model for the parasitism dynamics. The model was developed based on minirhyzotron observations under field conditions and was supported by experiments that were conducted under controlled conditions.

For model development, data of temperature and calendar days were converted to growing degree days (GDD) using β-function model and parasitism dynamics was obtained by the Weibull Equation. This equation allows predicting and analyzing the significance of the initial parasitism stage, (attachment size 1-2 mm) and the optimal stage for herbicide application. A first attachment was observed at 500 GDD while 63% from total attachments (a parameter that was extracted from Weibull Equation) appeared at 600 GDD and the maximum number of attachments appeared at 800 GDD.

Glyphosate was found to be the safest and the most selective herbicide to carrot. Herbicide control efficacy over time revealed that glyphosate (0.072 kg ha^{-1}) effectively controlled Egyptian broomrape when applied at 600 to 800 GDD and excellent control was achieved 150-300 GDD after herbicide application. A protocol for a rational management strategy for broomrape control based on parasitism dynamics was developed. The protocol proposed the commercial application of three sequential treatments of glyphosate at 650, 800 and 950 GDD based on the β-function model. This protocol was evaluated under field conditions and found to be robust and effective for broomrape control in carrot.

CALL FOR CONFERENCES

JOINT WORKSHOP OF THE EWRS WORKING GROUPS 'NOVEL AND SUSTAINABLE WEED MANAGEMENT IN ARID AND SEMI-ARID AGROECOSYSTEMS' AND 'WEED MAPPING'

29 September – 03 October 2013
Mediterrannean Agronomic Institute of Chania
Crete, Greece
http://confer.maich.gr/

The workshop aims to be informal and so stimulate as much discussion as possible among participants. As in past workshops, we will combine plenary scientific sessions with oral and poster presentations, round-table discussions, and a final plenary session (reports on round-table discussions, directions for the future, etc.). Additionally, some keynote themes will be organized and presented by invited speakers. Below is a tentative list of topics:

Novel and sustainable weed management in arid and semi-arid agro-ecosystems

- Weed biology, ecology and modelling
- Herbicide behaviour in soil and the environment
- Invasive weeds in arid zone: control and quarantine regulations
- Weed management in organic farming systems
- Preventive and integrated weed control (crop rotation, tillage system, etc.)
- Weed management in irrigated and non-irrigated crops
- Weed management in minor crops and special situations
- Cover crops, mulches and intercropping
- Site specific and precision agriculture - new developments and technical innovations
- Weed population dynamics in physical and cultural weed management systems
- Parasitic weeds and herbicide resistance
- Environmental impact of weed management

Weed Mapping

- Small scale weed mapping
- Regional mapping and country surveys
- Weed resistance mapping
- Mapping of invasive weeds
- Mapping of rare weeds
- The application of GIS systems in weed surveys
- The development of geodatabase for weed surveys and weed management
- Climatic change and weed flora shifts
- Weed distribution and land change

Subsidies for junior scientists

The EWRS will subsidise part of the expenses of junior scientists submitting an oral or poster paper. Details on when and how to apply for these subsidies will soon be disseminated through the Conference website and the EWRS website.

UPCOMING CONFERENCES AND WORKSHOPS

16TH EWRS SYMPOSIUM
24 – 27 June 2013
Samsun, Turkey
http://www.ewrs2013.org/default.aspx

9TH EUROPEAN CONFERENCE ON PRECISION AGRICULTURE (ECPA)
7 – 11 July 2013
Lleida, Spain
http://www.ecpa2013.udl.cat

12TH WORLD CONGRESS ON PARASITIC PLANTS
15 – 20 July 2013
Sheffield, UK
http://www.parasiticplants.org/

JOINT MEETING OF THE EWRS WORKING GROUP WEED MANAGEMENT IN ARID AND SEMI-ARID CLIMATE AND OF THE WORKING GROUP WEED MAPPING
29 September – 3 October 2013
Chania, Crete, Greece
http://confer.maich.gr/

AAB CONFERENCES ADVANCES IN BIOLOGICAL CONTROL / BIOPESTICIDES
15 -16 October 2013
Olde Barn Hotel, Marston, Lincs, UK
http://www.aab.org.uk/contentok.php?id=184&basket=wwsshowconflist

XIV CONGRESO DE LA SOCIEDAD ESPAÑOLA DE MALHERBOLOGÍA (SEMH)
5-7 November 2013
Valencia, Spain
http://14congresosemh.webs.upv.es

22ND COLUMA CONFERENCE – INTERNATIONAL MEETING ON WEED CONTROL
10-12 December 2013
Dijon, France
afpp@afpp.net – http://www.afpp.net

26TH GERMAN WEED SCIENCE CONFERENCE
11 -14 March 2014
Braunschweig, Germany
www.unkrauttagung.de

4TH INTERNATIONAL SYMPOSIUM ON WEEDS AND INVASIVE PLANTS
18 – 23 May 2014
Montpellier, France
http://www.ansespro.fr/invasiveplants2014/

18TH INTERNATIONAL PLANT PROTECTION CONGRESS "MISSION POSSIBLE: FOOD FOR ALL THROUGH ADEQUATE PLANT PROTECTION"
24 – 27 August 2015
Berlin, Germany
http://www.ippc2015.de/

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