FA1203: Sustainable management of *Ambrosia artemisiifolia* in Europe (SMARTER)

Training School Report

Training School – Controlling Common Ragweed by Vegetation Management

**Details**
Timing of Training School: 27-07-2015 to 01-08-2015

**Applicant details**

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**Trainer details**

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Additional help came from Rea Maria Hall, who gave a presentation about modern techniques of measuring environmental conditions as well as helped a lot in the preparation and administration of the Training School.

**Purpose and Summary of the Training School**

This Training School on Vegetation Management as a tool for controlling common ragweed was the first of its kind in Europe. It comprised of lectures, exercises in the class room and in the greenhouse as well as observations from field trials.

Under the guidance of well experienced researchers and leading scientists in the field of invasive plant ecology and management the participants improved their skills on designing,
performing, analysing and evaluating mowing/cutting experiments with and without competition - to control common ragweed (Ambrosia artemisiifolia). The training offered insights of how to measure and analyse relevant response variables and to estimate their control efficacy. The participants also could increase their knowledge about how to quickly evaluate field experiments with respect to efficacy in harming spontaneous ragweed populations. One class included the use of R for analysing the data from experiments that were set up specifically for this TS. Furthermore, the trainees were taught the context depended use of electronic tools to characterize stand and habitat features.

The participants should increase their individual skills in designing experiments and analysing the data by adequate statistics. Specific experiments were set up to be finished and analysed during the course. A final paper is planned to be published from this experiment. Possible mistakes and pitfalls in experimental design and statistical analysis were discussed. When visiting the field experiments representatives of relevant stakeholders like the road maintenance services were present to be demonstrated the effectiveness of the tested cutting treatments. The participants were enabled to directly discuss the options and limitations of control measures along roadsides. A schedule illustrates the activities during the whole week of the TS (added towards the end of the report).

The training school was aimed at young scientists (PhDs and early postdocs) but also on senior scientists that have influence on the education of younger scientists and are active in increasing the awareness of the common people and stakeholders to fight common ragweed with the right tools.

Applicants’ statements about the benefits of the Training School

Ahmet Uludağ: Igdir Universities, Turkey, Associate Professor:
I am a professor on weed science and invasive alien species who has knowledge on the scope of the summer school. The course helped me to improve my statistical skills, especially using R programming for ecological research. I have seen Ambrosia management, which is the first time for me. I had knowledge on cutting and plant seed adding. It was unbelievable how big problem Austria is facing. Farmers need to be trained more. The work of roads authority was amusing. It shows how collaboration is important between science and practice.

Bojan Konstantinovic: University of Novi Sad, Serbia, Assistant Professor:
As Assistant Professor at Department of Environmental and Plant Protection, Faculty of Agriculture, University of Novi Sad, Serbia, with more than 10 years’ experience working with ragweed, I found the participation on the Training School very useful. It was a great opportunity to acquire competence in vegetation management and to compare experiences and weed control methods in Serbia and Austria. Different approach in road weed
management in Prof. Karrer's trials in Austria will be great base for trials in Serbia as well as, hopefully, new approaches in road weed management in Serbia.

Information about R statistics, that we collected, will be very useful for further experimental analysis.

The greenhouse experiments in Freising were a great opportunity for exploring possibilities of new approach for ragweed trials. Determination of all parameters influencing Ambrosia (and Solidago as another invasive plant species tested) can be very useful for further research.

Also, the new insights about grasslands in Bavaria, field production and farming in Austria as well as pumpkin production were very interesting and useful.

**Christina Tirler**: University of Natural Resources and Life Science Vienna, Austria, PhD:
The SMARTER Training school was a great opportunity to develop further skills and broaden my knowledge in controlling common ragweed (Ambrosia artemisiifolia). The broad spectrum of lectures and the greenhouse experiment allowed a closer look in ongoing research on this invasive species. For me, a PhD student at the University of Natural Resources and Life Science Vienna (BOKU), it served furthermore as a great opportunity to meet experts from several different countries. This helps to build a network among researchers in the field I am working in (invasive plants), as well as related scientific areas. I highly appreciated that we set up a greenhouse experiment and went through the whole process of performing as well as analysing such an experiment and the dataset we obtained. The data analysis in R was an added bonus for me, as I was not very familiar with this software before the SMARTER Training School. The presentations as well as the excursions and discussions with other participants guided by several experts were highly beneficial for me. The mowing and cutting experimental plots and the challenges experts are facing related to populations of common ragweed along roadsides was another interesting aspect that was highlighted during the Training School. In conclusion I have to say that I personally learned a lot about controlling methods of Ambrosia artemisiifolia whilst participating in the Smarter Training School. Primarily I profited from theoretical input provided by the organizers, discussions, as well as interexchanges with other participants.

**Dragana Bozic**: University of Belgrade-Faculty of Agriculture, Serbia, Assistant Professor:
My participation in Training School entitled as “Controlling Common Ragweed by Vegetation Management” is important for my research and educational activities at the Faculty of Agriculture, University of Belgrade, where I am employed as Assistant Professor at Weed Science Laboratory. Namely, although invasive plants are significant part of my researches, I have no had experience with vegetation management until now. The knowledge and experience gained during the training school will allow me to expand my research with new experiments with aim to control weeds by vegetation management. Also, I will include vegetation management as tool for weed control in my lectures for students on different levels of studies (BSc, MSc and PhD). In addition, I plan to focus one PhD thesis to research of common ragweed control in infested arable fields by sowing grass mixtures which can be used to feed livestock. All mentioned activities can improve research and educational activities on my faculty and can provide new projects.
In addition to the benefits for me personally and for my institution, training school is important for the wider community. The improvement of common ragweed control by application of knowledge and experience from training school will reduce the population of this species, which is important both for the people that has trouble with allergies to ragweed, and for the farmers whose fields are highly infested with this species. Also, my knowledge may be beneficial for services responsible for the control of ragweed and other weeds along roads. Improvement of common ragweed control based on knowledge and experience from Training School can have a multi-economic benefits for my country. Namely, it will reduce the costs of medication of people which are allergic to ragweed, then the cost of weed control in arable lands, as well as the costs of suppressing of ragweed along roads. Also, positive economic effect can be reached thank to higher crop yields due to more efficient ragweed control in the fields.

_Eugenia Nagodă:_ Botanic Garden “D. Brandza” of Bucharest University, Romania, Biologist:
I am very grateful for this opportunity. I had the opportunity to learn about how to design, how to run analysis and evaluate mowing experiments, both in greenhouse conditions and in field conditions (roadsides).
I have learnt something about competition (using species from native flora) in order to control of Ambrosia artemisiifolia. Also, I acquired some basic knowledge about “R Studio” program, necessary for future possible experiments, regarding common ragweed and another invasive species.
I want to address my sincerely thanks to all trainers: Gerhard Karrer, Johannes Kollmann, Tina Hager and Florencia Yanelli for sharing us important knowledge about Ambrosia artemisiifolia. It was a real pleasure to meet another scientists which had some similar interest and sharing experience with them.
I am grateful for the opportunity to see different aspects of life, living and nature from both Germany and Austria.

_Katalin Erzsébet Nagy:_ University of West Hungary Mosonmagyaróvár, Hungary, PhD:
For me personally it was a great experience to attend the SMARTER Training School on Controlling Common Ragweed by Vegetation Management. It was a pleasure meeting you, and spending a productive week with you.
I have had the opportunity to learn how to investigate the efficacy of vegetation management to control common ragweed (Ambrosia artemisiifolia).
The experiment set up in the greenhouse was very useful to show us the test theories. I think that these kind of experiments can be very useful to justify the importance of the field experiments. Analysing the collected data in group by the R-Studio statistical program, we have had the opportunity to know this program, which is a free programming language for statistical computing and graphics. I’m sure that I will use this program in the future for other kind of data analyses too.
The field experiments showed us some possibilities to control spontaneous ragweed populations on the roadside, using different seed mixtures and cutting regimes. This kind of management would be useful in Hungary too, because the Ambrosia artemisiifolia often is a problematic weed on our roadsides.
I enjoyed the city tour in Freising, the excursions in Bavaria and in Austria. I am grateful that I could be a member of this group, and I hope that in the future we will have the opportunity to share more experience and knowledge referring on controlling Ambrosia artemisiifolia or other invasive weed species.

**Ligita Boležentienė:** Aleksandras Stulginskis Univeristy, Lithuania, Prof., principal researcher:
The Training School on Controlling Common Ragweed by Vegetation Management gave the opportunity to see how multifactorial experiments of plant competition/restoration were performed in two sites, namely, greenhouse (by Florencia) and in situ, e.g. on different roadsides (by Gerhard, BOKU) and restoration sites (by Johannes, MTU). It became clear what lessons it gives for making theoretical or practical conclusions for the application in practise. The R-studio affords (with Tina and Florencia, MTU) to perform and evaluate statistical evidence and present for publication/presentation the experimental data were also extremely valuable. All these knowledge and grown practical experience acquired in countries, where the Training School was organised, will be applied in my tutoring of MSc and PhD student.

**Maja Scepanović:** University of Zagreb, Croatia, Assistant Professor:
I was participant of Summer Training School 2015 organized by SMARTER. My participation on this summer school was very important for my further scientific work at University of Zagreb where I am working as Assistant professor at Weed Science Department. Furthermore, the knowledge and ideas obtained at this summer school I will include in lectures for courses Fundamentals of Weeds Science and Weed Ecology, that I am coordinator at my UNI.

Although I have been dealing with weed species Ambrosia artemisiifolia for many years this was my first time to see the mowing/cutting experiments with and without competition aiming at the control of this invasive weed species. The experience gained during this summer school will allow me to expand my research with new experiments on controlling weeds with vegetation management.

The greenhouse experiments in Freising where experiments on competition between mix of native species and invasive species (Ambrosia artemisiifolia and Solidago gigantea) were set up, gave me a better understanding in measurements techniques, the analyses of the most relevant response variables, experimental set up design and data recording. Furthermore, the R statistics tutorial that we have been working with will be beneficial in my further experimental analysis.

The field experiments to find the optimum cutting regime and the most effective competitors (seed mixtures) against ragweed along roadsides in Austria showed me possibility for efficient control of common ragweed. The experiments are even more valuable and credible because they were conducted five of six year ago and now we have had possibility to see the long-term effect on common ragweed. This kind of management would be very useful in Croatia too, since this weed species is mostly always present and problematic on our roadsides.

I am very grateful that I had possibility to participate at Summer School on Controlling Common Ragweed by Vegetation Management and to have possibility to meet the
colleagues and teacher for other countries hoping that all this will result with joint experiments regarding management of this invasive weed species.
Sincerely thanks to all trainers of SMARTER Training School 2015: Gerhard Karrer, Johannes Kollmann, Tina Hager, Florencia Yanelli, and Rea Hall for all help and excellent organisation skills

Rea Hall: University of Natural Resources and Life Science Vienna, Austria, PhD:
First, I would like to thank Gerhard Karrer, Johannes Kollmann, Florencia Yanelli, and Tina Heger and of course COST for the possibility to participate in this SMARTER Training School. It was really a great pleasure meeting other PhD-students and researchers who have such an advanced experience in working with A. artemisiifolia and other weeds. Besides that, the many interesting and fruitful discussions with the other participants opened new ideas and new possibilities for my future research. It was really very exciting and enriching that the participants are working in different fields of research (agricultural sciences, ecological research, phytomedicin, etc.) so that all topics were discussed from different perspectives which generated new ideas for future research co-operations. For example, Siegrid Widhalm who is working with endophytes as control agents of A. artemisiifolia on the experimental plots in Seyring/Lower Austria and me will start measuring the LAI and the biomass as well as the viability of the ragweed seeds after ripening. This cooperation was fixed during Training School after I introduced possible measurement techniques and devices for ecological research.
For me it was very interesting to get this detailed comparison between greenhouse experiments and field trials. Here, I came to the conclusion that greenhouse experiments are very useful for pre-trials to test basic ecological functions and response patterns without any bias due to environmental factors. But because of my scientific agricultural background I know that in most cases the results of greenhouse trials can’t be compared with the results researchers get in the “free” field. This was even more enhanced by comparing the results of the greenhouse experiment in Freising and the results we have monitored on the different roadside-plots in Austria. Even though all communities – in Freising as well as on the plots in Austria – were designed, it became obvious that especially under field conditions the site specific dynamics of the soil seed bank, spontaneous establishment of ruderal species as well as natural succession were main factors influencing the vegetation and thus the competition on the plots. Furthermore, environmental factors like drought, the presence of hedges, road lane slopes etc. played a major role.
Beside this experimental plots along the road verges a personal highlight was also the excursion to the ragweed-infested fields, which brought up new ideas for future research, for example:
1) Which influence has the crop rotation on the establishment success of ragweed?
2) In Styria, ragweed is most abundant in maize, pumpkin, soybean and sugar beet, all crops with low input of herbicides but a high number of transits due to the necessity of shearing, fungicide application, fertilization etc. Thus, there is reason to believe that land machinery, particularly inter-company land machinery use is one of the main distribution mechanisms of A. artemisiifolia. This is enhanced by the fact, that machinery hygiene is not or only seldom considered in practical farming. Because of ever stricter regulations on herbicide use, changing climate conditions favouring the establishment of ragweed and other weeds in
non-native environments and increasing inter-company land machinery use it would be interesting to research the distribution potential and patterns of ragweed due to spread by machinery and road side management machinery.

Siegrid Widholm: AIT Austrian Institute of Technology, and BOKU, Austria, PhD:
As a PhD student working on biocontrol of common ragweed, I was excited to be part of this training school. It was a great opportunity to acquire competence in vegetation management.
Not only the greenhouse experiments but also the field trials gave me a better understanding in experimental setup design and data recording. The hands-on approach in the greenhouse, collecting data as well as analysing the data together was a great idea and helped to get a holistic understanding of the design and evaluation of an experiment. Especially, the R statistics tutorial will be beneficial for my further experimental analysis. Furthermore, I had the possibility to introduce my field experiment to the group which led in my opinion to a very fruitful discussion and new ideas that I will be implementing in my future work.
When visiting the experimental plots of Prof. Karrer in Styria I learned the importance of working together with the state road management staff when it comes to controlling common ragweed or any other invasive plant. Raising awareness when fighting invasive species should be an interdisciplinary approach, where politics and science meet. Lastly, meeting scientist from different fields working on the same topic was very inspiring and I will do my best to impart the knowledge that I obtained in my institute.

Additional Basics and outcomes from the Training School
On the extranet you can find a detailed report of the performed experiments in the greenhouse as well in the field, showing details of the design and results. This special report was basically provided by Rea Hall and compiled to the final version by Gerhard Karrer using minutes of the day written by the participants.

Ao. Univ.-Prof. Mag. Dr. Gerhard Karrer
Institute of Botany, Department of Integrative Biology and Biodiversity Research
University of Natural Resources and Life Sciences Vienna
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I confirm that the SMARTER Training School on “Controlling Common Ragweed by Vegetation Management” was executed as planned and that all participants performed well.

Vienna, 31-08-2015