CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

WORKSHOP OF THE EWRS WORKING GROUP 'WEED VEGETATION AND BIODIVERSITY'

Prague, Czech Republic, 10th to 12th of May 2023

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SCIENTIFIC PROGRAMME

TUESDAY MAY 9, 2023

19.00 - 21.00	**Welcome reception at the Czech University of Life Sciences Prague campus**

WEDNESDAY MAY 10, 2023

9.00 - 9.20	Opening speech and welcome to the workshop by Prof. Josef Soukup, EWRS President and Matthias Schumacher, Leader of the Working Group Weed Vegetation and Biodiversity
9.20 - 10.20	**KEYNOTE LECTURE: "Weed surveys – a window to changes in agriculture"** Jukka Salonen (LUKE, Finland)
10.20 - 10.40	**Coffee Break**
Session 1	***Weed community changes and biodiversity conservation***
10.40 - 11.00	**"**Lessons from the losers of biodiversity change in Central European arable fields**"** Michael Glaser; Swen Follak; Zdeňka Lososová; Stefan Dullinger; Franz Essl
11.00 - 11.20	**"**The status of 102 segetal plant species across 37 European red lists reveals their drastic state of conservation**"** Guillaume Adeux; Jocelyne Cambecèdes
11.20 - 11.40	**"**Can road verges act as a natural refuge for weeds?**"** Mariana Fernandes; Paula Matono; Anabela Belo
11.40 - 12.00	**"**Promoting plant diversity in vineyard agroecosystems: flagship species selection and conservation measures at Yvorne (Switzerland)**"** Matteo Mota; Serena Fantasia; Sébastien Meylan; Dorothea Noll; Thierry J Heger; Jean-Philippe Burdet; Raymond Delarze
12.00 - 13.30	**Lunch**
Session 2	***Weed surveys, mapping and beyond***
13.30 - 13.50	**"**Weed vegetation in cultivated sage (*Salvia officinalis* L. and *Salvia fruticosa* Mill.) in Türkiye: diversity and species composition**"** Esra CIGNITAS; Fatma UYSAL; Tuba BESEN; Kadriye YUKSEL; Yasin Emre KITIS
13.50 - 14.10	**"**Weed occurrence on soil deposits in sugar factory**"** J. Holec; M. Jursík; D. Hiřmanová; J. Soukup
14.10 - 14.30	**"**The aggregated spatial pattern of weeds: insights from maize, onion, and pasture**"** Gal Rozenberg; Yohay Carmel; Lior Blank
14.30 - 14.50	**"**Beyond weed distribution maps**"** Mona Schatke; Lena Ulber; Talie Musavi; Jana Wäldchen; Christoph von Redwitz
14.50 - 15.10	**"**Biodiversity and weed control in railway networks: insights from a plant inventory**"** Rakotoson Tiana, Mediene Safia, Meynard Jean-Marc, Valantin-Morison Muriel
15.10 - 15.30	**Coffee Break**

Session 3 ***Accounting for weeds in management***

15.30 - 15.50 **"**Quantifying the contribution of weeds to ecosystem (dis)services: from weed survey to proxy values**"**
S. Cordeau; S. Yvoz; S. Petit

15.50 - 16.10 **"**An approach to add weed existence values in an economic threshold concept**"**
Johanna Sophie Bensch; Friederike de Mol; Bärbel Gerowitt

THURSDAY MAY 11, 2023

Session 4 ***Methods***

8.40 - 9.00 **"**Vegetation survey methodology in segetal weeds is reported with differing degree of details depending on survey aims – literature review**"**
Filip Küzmič; Jana Bürger

9.00 - 9.20 **"**Concept for a national weed monitoring in Germany**"**
Christoph von Redwitz; Lena Ulber

9.20 - 9.40 **"**Species-area relationship in weed sampling of Finnish spring cereals**"**
Terho Hyvönen, M. Niemi, Jukka Salonen

9.40 - 10.00 **"**Thermography – new method to identify weeds?**"**
Hana Vašková; Jan Lukáš

10.00 - 10.20 **Coffee Break**

Session 5 ***Changing perspective***

10.20 - 10.40 **"**Weed monitoring with citizen science data**"**
Silvia Fogliatto; Zineb Bennani; Giulia Papandrea; Francesco Vidotto

10.40 - 11.00 **"**Perception of weeds and their ecosystem (dis)services by farmers, advisors, experimenters and researchers in France**"**
S. Cordeau; M. Schwartz

11.00 - 11.40 **"**Input: Interaction with policy makers**"**
Bärbel Gerowitt

12.00 - 17.00 **Field Trip to Lupofyt farm (typical Czech crops hop and poppy)**

19.00 **Dinner in the Prague city centre (Restaurant "U Pinkasů")**

FRIDAY MAY 12, 2023

Session 6 ***Shaping weed communities I***

9.00 - 9.40 **Poster Session**

9.40 - 10.00 **"**Relationships between plant species, earthworm abundance and soil physicochemical parameters in Swiss vineyards**"**
Serena Fantasia; Antoine Faggion; Thierry Heger; Renée-Claire Le Bayon; Frédéric Lamy; Matteo Mota

10.00 - 10.20 **"**Factors influencing weed species composition in Hungarian phacelia fields**"**
Gyula Pinke; Éva Dunai; Bálint Czúcz; Zoltán Botta-Dukát; Ákos Bede-Fazekas

10.20 - 10.40 **Coffee Break**

Session 7 ***Shaping weed communities II***

10.40 - 11.00 **"**Service crops as a component in weed control interface for field crops**"**
Eilon Winkler; Gil Eshel; Maor Matzrafi

11.00 - 11.20 **"**Effect of cover crops and tillage on the weed seedbank**"**
KL Gage; MR Trader; DA Scott; KWJ Williard; JE Schoonover; R McElroy; A Sadeghpour

11.20 - 11.40 **"**Climatic perspective to weed management- untangling the effects of local, management and climate factors on the infestation of *Amaranthus* species**"**
Roni Gafni; Hanan Eizenberg; Lior Blank

11.40 - 12.00 **"**Incidence of species with reported herbicide resistance in Czech arable weed communities**"**
TA Reinhardt Piskackova; Michaela Kolářová; Luděk Tyšer; Thien Hoová

12.00 - 13.30 **Lunch**

Session 8 ***Seed predation***

13.30 - 13.50 **"**Quantification of the contribution of weed seed predators to crop yield**"**
Bruno Chauvel; Lucile Muneret; Benjamin Carbonne; Chantal Ducourtieux; Nicolas Henon; Emeline Felten; Emilien Laurent; Annick Matéjicek; Sandrine Petit-Michaut

13.50 - 14.10 **"**Comparing seed predation in a native prairie patch with surrounding pulse crop fields**"**
Christian Willenborg; Stefanie De Heij

14:10 - 15.00 Collaboration Initiatives, Closing the workshop

POSTERS

1) **"**Distribution of the weed flora in a small agricultural landscape**"**
Emeline Felten; Sandrine Petit; Bruno Chauvel

2) **"**Surveys on weeds in spring cereals fields in Finland**"**
Jukka Salonen; Heikki Jalli; Anne Muotila; Pentti Ruuttunen; Terho Hyvönen

3) **"**Evaluation of the impact of aerobic and flooded rice cultivation on weed flora composition in Iran**"**
Sima Sohrabi; Javid Gherekhloo

4) **"**The effects of site-specific environmental conditions on weed species composition in small-scale vineyards in Serbia (SE Europe)**"**
Ana Anđelković; Danijela Pavlović; Miloš Rajković; Slađana Popović; Dragana Marisavljević

5) **"**Management of *Lupinus polyphyllus* to restore the habitat for *Knautia arvensis***"**
Zahra Bitarafan; Victoria Stornes Moen; Ove Hetland; Inger Sundheim Fløistad

6) **"**Past and present weed vegetation at Ljubljansko barje area, Slovenia: preliminary results**"**
Taja Skrt Kristan; Filip Küzmič; Tjaša Tolar

7) **"**Can conservation agriculture deeply change the structure of weed communities?**"**
Bruno Chauvel; Damien Derrouch

8) **"**Incidence of thermophilic, grass and rare arable weeds in cereal fields in the Czech and Slovak Republic**"**
Michaela Kolářová; Theresa A. Reinhardt Piskáčková; Luděk Tyšer; Jana Májeková

9) **"**Noxious weed species in sugar beet stands in the Czech Republic**"**
J. Holec; M. Jursík; D. Hiřmanová; J. Soukup

10) **"**Biodiversity of weeds among horticultural Crop Wild Relatives in Poland**"**
Denise F. Dostatny

11) **"**Comparing vegetation in new and old field boundaries: how important are weeds?"
Alicia Cirujeda; Ana Isabel Marí; Sonia Murillo; Joaquín Aibar; Fernando Escriu; Jorge Pueyo; Gabriel Pardo

12) **"**Weed and soil microbiome diversities effects on wheat yield under two management systems**"**
Eva Hernández Plaza; Fernando Bastida; Valle Egea Cobrero; Jordi Izquierdo; González-Andújar José Luis

Weed surveys – a window to changes in agriculture

Jukka Salonen

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During recent decades, arable cropping has been intensified to increase production but has also been constrained by agri-environmental schemes. Weed species occurrence is known to change in response to agricultural practices and environmental factors. Repeated monitoring of the weed flora and cropping practices aims to record and understand the response of weed populations to changing agricultural conditions. Long-term changes in arable cropping in Finland include interest in organic farming, increased spring cereal dominance and a selection of registered herbicides while more recent trends include restricted use of nitrogen, reduced tillage and reliance on glyphosate use. The composition of weed flora in spring cereals has been investigated in Finland since the early 1960's. The fifth survey was conducted during 2020-2022. Both conventionally and organically cropped fields have been included since the 1990's. The occurrence of weed species has been assessed from ten randomly placed sample quadrats per field in mid-July when cereals have reached the heading stage. Weed occurrence is determined in frames measuring 0.1 m2 (abundance) and 1.0 m2 (species number). In total, 139 weed species, primarily broad-leaved species, were found during 2020-2022. No major changes in the frequency of the most common species *Viola arvensis*, *Stellaria media*, *Chenopodium album*, *Galeopsis* spp. and *Lapsana communis* were detected. On the other hand, *Poa annua* and *Veronica* spp. had become more frequent during the last 15 years. The area of organic farming has steadily increased in Finland being now almost 15% of the cultivated area. Cropping system clearly affects the composition of weed flora; the average number of observed species was 20 in organic fields and 12 in sprayed conventional fields. The most notable differences in the species frequency between organic and conventional farming were found for *Erysimum cheiranthoides* (84% in organic vs. 10% in conventional), *Vicia* spp. (59 vs. 5), *Spergula arvensis* (74 vs. 27) and *C. album* (99 vs. 43). A special attention in the latest survey was paid to the incidence of herbicide resistance, *Stellaria media* expected to be the most common indicator species. Only some clear positive resistance observations were recorded. Apparently many farmers have successfully reacted to resistance by using herbicide products which are still effective against sulphonyl-resistant *S. media*. Monitoring weeds and delivering information on weed biology and weed incidence in arable fields is highly advantageous in developing and supporting weed management strategies. Weeds are important also to other trophic levels in farmland. Therefore, when conducting weed surveys, both agricultural and biodiversity aspects should be addressed.

Keywords : biodiversity, herbicide resistance, organic farming, *Viola arvensis*, weed shift

Lessons from the losers of biodiversity change in Central European arable fields

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Central European arable fields are undergoing drastic changes in biodiversity driven by changes in land use intensity and agricultural practice. With climate change having just entered its accelerating phase, it is clear that larger biodiversity change, possibly even large-scale biodiversity loss, is on the horizon for this group of habitats covering around one-fifth of Central Europe. We investigated species' changes in range size between 1930 and 2020 in an analysis of the AgriWeedClim database in a previous study (Glaser et al. 2022) which revealed that the biggest "losers" of this biodiversity transition are species with a preference for nutrient-poor habitats, extreme soil pH as well as species with a high affinity to arable habitats. For the study presented here, we investigated these "losers" in-depth, especially regarding their life strategies and traits. While some species have rather specific reasons for range losses (i.e., relating to specific changes in agricultural practice such as seed cleaning), we aimed to create a general analysis of factors contributing to the biodiversity losses in Central European fields. We show how some strategies that made species well-adapted to past agricultural practices nowadays, after almost a century of agricultural intensification and land use change, contribute to range losses. The results of our study can be used to identify conservation goals at the regional level as well as to inform conservation strategies for arable biodiversity.

Keywords : weeds, modelling, species decline, traits, ecological indicator values

Acknowledgements : This study was funded by the Austrian Climate Research Programe (FA772033 "AgriWeedClim")

The status of 102 segetal plant species across 37 European red lists reveals their drastic state of conservation

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The declining trend of segetal plant species has been highlighted by small-scale studies scattered around different European countries. Hence, a complete picture of the conservation status of a wide set of segetal plant species in Europe is currently missing. Red lists are elaborated following a similar methodology (developed by the International Union for Conservation of nature (IUCN)) and their compilation represents one way of assessing the conservation status (NT: near threatened; VU: vulnerable; EN: endangered; CR: critically endangered; RE: extinct) of numerous species at a continental scale. Here, we assessed the conservation status of 102 segetal plant species (French national segetal plant list) across the red lists of 37 European countries. Information concerning species presence/absence and residence status (native/archeophyte vs. neophyte) in the different countries was also gathered across a diversity of databases. Of the 102 species considered, over 70 were present in Western and Mediterranean countries and a large proportion was considered as native/archeophyte. Northern countries (Baltic, Scandinavian, British Isles) counted less species and a large proportion was considered as neophytes. Most species (84) were found in 10 countries or more (*e.g. Alopecurus myosuroides*). Nevertheless, 11 of these were considered as archeophytes/natives in less than 10 countries (*e.g. Ridolfia segetum*). Seven species were almost always considered as neophytes in the countries where present (*e.g. Tulipa* spp.). Fifteen species showed restricted distributions, mainly around the Mediterranean Sea (*e.g. Nigella* spp., *Delphinium* spp., *Silene* spp., *Hypecoum* spp.). On average, red lists included 16 of the 102 considered species, with important differences between countries (*e.g.* 0 for Denmark and 51 for Switzerland). Central European countries (*e.g.* Luxembourg, Belgium, Germany, Austria) usually had the highest count of species considered as CR or RE. On average, each of the 102 considered species was found in 6 national red lists, with important differences across species (*e.g.* 22 species present in more than 10 lists and 11 in none). Species most frequently considered as CR or RE were *Agrostemma githago*, *Asperula arvensis*, *Scandix pecten-veneris*, *Gypsophila vaccaria*and flax specialists. Four species with restricted distribution were absent from all lists (*Tulipa lortetii*, *Nigella hispanica* subsp. *hispanica*, *Delphinium halteratum* subsp. *halteratum*, *Silene conoidea*), even though usually considered natives/archeophytes. The state of European segetal flora may be even more drastic as segetal species are not necessarily considered for red list assessments, even in hot-spots where they are known to be declining (*e.g.* Spain, Portugal, Italy). Data from south eastern countries was lacking and botanical assessments in these regions may temper the drastic state depicted here. We encourage the elaboration of a European segetal plant list and programs specific to different subsets of segetal plants (*i.e.* wide distribution but often red-listed vs. restricted distribution).

Keywords : weed diversity, rare arable plants, archeophyte, weed distribution

Acknowledgements : Observatoire Français de la Biodiversité

Can road verges act as a natural refuge for weeds?

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Native vegetation within an agricultural field is usually considered a weed. Weeds can represent a critical agricultural constraint as they compete for resources and can negatively affect crop production. However, weeds play a key role in agroecosystems because they are also essential to sustain biodiversity in agricultural landscapes by supporting food webs and ecosystem services, like pollination and pest control, or by protecting the soil. In the last decades, weeds diversity and the associated fauna are declining due to the intensification of agricultural practices, compromising the agroecosystem's proper functioning and impairing biodiversity. A once diverse floristic community is currently dominated by those few species that can cope with the agricultural intensification process. The loss of weed diversity in agricultural fields is a global issue that needs to be counteracted to preserve their supported ecosystem services and food webs. Marginal lands, i.e., land with little or no agricultural or industrial value, can be a refuge for agroecosystems' biodiversity and help to counteract the decline of weeds and their associated fauna. Road verges are marginal lands widespread across agricultural landscapes that can have the potential to act as a refuge area for plants banned from neighbouring agricultural land. This study aimed to assess the potential of road verges for plant conservation in a Mediterranean agricultural landscape by comparing plant diversity of vineyards and olive groves inter-rows and their adjacent road verges. The study occurred in South Portugal, a Mediterranean area characterized by an expanding agricultural matrix of vineyards and olive groves. Thirty intensively managed plots (15 vineyards and 15 olive groves) were selected. Herbaceous floristic communities in the agricultural areas and adjacent road verges were characterized and compared through floristic surveys in spring 2021. We have found that, although road verges have a similar level of disturbance, reflecting identical management, the floristic communities of agricultural areas and respective road verges are different. Road verges register a significantly higher floristic richness and diversity, highlighting the role of road verges as a refuge for plants in areas dominated by agriculture. These results reinforce the importance of road verges as a conservation tool, especially in intensive agricultural matrices.

Keywords : weed conservation; linear infrastructure-related habitats; plants refuge; agriculture matrix; vineyard, olive grove

Acknowledgements : This work is funded by National Funds through FCT under the PhD grant 2020.06339.BD.

Promoting plant diversity in vineyard agroecosystems: flagship species selection and conservation measures at Yvorne (Switzerland)

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The Swiss wine market is under pressure from high production costs and growing international competition. In response, some regions promote their environmental efforts to justify higher bottle prices. One such example is the commune of Yvorne, located in the canton of Vaud in Switzerland. Here, the "Yvorne Grandeur Nature" project is underway with the aim of making the Yvorne region a model of sustainable development by promoting vineyard biodiversity. To achieve this goal, a study was conducted to define flagship plant species and associated conservation measures. The species were selected from a total of 384 vascular plant species reported from a previous study. The selection of the species was based on three criteria: their rarity in Switzerland, their strong associations with vineyard agroecosystems (i.e. weeded perennial crop under dry and hot conditions), and their aesthetic aspects. Four flagship species were selected: *Calendula arvensis*, *Orlaya grandiflora*, *Misopates orontium* and *Althaea hirsuta*. To better understand the conditions that allow the survival of these rare and under threat species in Yvorne, inventories were carried out three times along two routes of ca. 3 km through the vineyard. Interviews were conducted with winegrowers to acquire complementary information on the management of the plots concerned. The populations of *C. arvensis* were found to be relatively abundant in a rather broad range of ecological situations, especially in sparsely vegetated areas (i.e. dry soils with chemical or mechanical weed control). Only two populations of *O. grandiflora* were reported on well-exposed dry grasslands at the edge of vineyards. Neither *M. orontium* individuals nor *A. hirsuta* were found along the surveyed route areas. Seeds of *C. arvensis* and *O. grandiflora* were collected, and germination tests are currently being carried out in a climate chamber under different conditions. Our preliminary results show that the populations of three out of the four flagship species are isolated and small, making them vulnerable. The information obtained from the winegrowers as well as the results of the germination tests will help us to better understand the environmental factors as well as the management practices favouring the development of the investigated species. Furthermore, the multiplication of seeds by a local seed company and the establishment of farming management guidelines will contribute to the extension of populations of these species, as well as other rare species requiring similar ecological conditions.

Keywords : Weed diversity; viticulture; rare weeds; emblematic weeds; perennial crop.

Acknowledgements : This project was funded by the MAVA Foundation.

Weed vegetation in cultivated sage (*Salvia officinalis* L. and *Salvia fruticosa* Mill.) in Türkiye: diversity and species composition

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Salvia is the largest genus of Lamiaceae family distributed throughout the world, with some species having economic importance. Two important species cultivated in Türkiye are *Salvia officinalis* L. and *Salvia fruticosa* Mill. The aim of this study has been to identify weed flora in sage cultivated areas to plan further weed management strategies at agroecosystem level. Surveys were carried out in a total of 105 sage fields corresponding to an area of about 38 hectares in Mediterranean region. The surveys were conducted according to the systematic sampling method depending on the size of the fields. The collected data were analysed by means of quantitative measures such as frequency (%) and density (plant/m^2). Ninety different weed species including 77 dicotyledons and 13 monocotyledons were found at the end of the surveys. The first three families with the highest number of species were Asteraceae family with 14 species, Poaceae with 13 species, and Fabaceae with 9 species. The highest frequency values were recorded by *Avena sterilis* L. (83%), by *Convolvulus arvensis* L. (61.9%), and by *Trifolium pratense* L. (60%). The highest plant densities per square meter were found in *Glebionis segetum* (L.) Fourr. (27.23 plant/m^2), *Alopecurus myosuroides* L. (13.01 plant/m^2) and *Anthemis arvensis* L. (10.69 plant/m^2). Simpson's diversity index showed high weed diversity in the sage cultivation areas with different density of weed species; the family with the highest number of species in this survey was the Asteraceae family. Considering this important role of the wild ornamental flowers on biodiversity and ecosystem services of the plant-pollinator communities and their interactions, in the Mediterranean agroecosystems sage growers could use combining multiple tools and techniques in an Integrated Weed Management strategy to manage weeds. The ambition should be not the eradication of weeds, rather to limit their negative effects, conserving diversity. This is the first study on weed vegetation in cultivated sage in Türkiye.

Keywords : sage weed, biodiversity, integrated weed management

Acknowledgements : This study was supported by Republic of Türkiye Ministry of Agriculture and Forestry-General Directorate of Agricultural Research and Policies with the project (No: TAGEM/BSAD/Ü/21/A2/P4/3967)

Weed occurrence on soil deposits in sugar factory

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Soil form sedimentation ponds of sugar factory is stored in mounds to get dry for 3 years. During that time weed vegetation occurs on the mounds producing seeds forming soil seed bank that can be risky for future use of the soil. We investigated plant species occurring on mounds 1, 2, and 3 years old in the area of soil deposits of TTD Dobrovice sugar factory in 2020-2022. Plots 2 x 2 m were used in 3 replicates to observe plant species coverage on mounds of each age. Mean coverage and frequency was calculated for each species. During the first year of deposition, two species showed high dominance: *Atriplex prostrata* and *Chenopodium rubrum*, Together they represent ca. 80 % of plant cover. These species occur as a result of their presence in the area of sedimentation ponds. They are tolerant to high soil moisture and can germinate in very wet substrates, which is typical for soil mounds in the first year. *Chenopodium album* and *Echinochloa crus-galli* were also recorded but with much lower coverage. During the second year of deposition, *A. prostrata* and *C. rubrum* were still among dominant species, but *Atriplex sagittata* showed similar coverage. *C. album* is a frequent species with 15 % cover. High frequency but low cover show *E. crus-galli* and *Persicaria lapathifolia*. In the trird year, cover of *A. prostrata* and *C. rubrum* decreased significantly, dominant species were *C. album* (43 %) and *A. sagittate* (32%). In this year, vegetation typical for ruderal habitats with higher nutrient content and medium soil moisture formed. During first two years of deposition *A. prostrata* and *C. rubrum* can produce high amount of seeds but those seeds do not pose any risk for future agricultural use of the soil. These two species are not competitive under normal field conditions and thus it is not necessary to control their occurrence.

Keywords : soil seed bank, soil deposites, weed vegetation, *Chenopodium album, C. rubrum*.

The aggregated spatial pattern of weeds: insights from maize, onion, and pasture

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Understanding how weeds spread in fields is a central theme in the agricultural literature, with implications for weed community assembly, weed management, and herbicide use. The patchy spatial distribution of weeds is reported in the literature and lies at the core of site-specific weed management approach (SSWM). Considering the heterogeneity of agricultural systems and the differences in dispersal, phenology and life form of weed species, it remains unclear how general this phenomenon is. Here, we report findings from three studies. The spatial pattern of weeds was studied in three distinct agrosystems, and at two ecological levels: dry onion (weed community), maize (both single species and weed community) and bahiagrass pasture (single species). The weed community at the end of the growing season in 11 commercial onion fields was highly clustered, and this result was independent of weed coverage which varied largely between fields (1% to 79%). We also found aggregated distribution for the invasive giant smutgrass in bahiagrass pastures in Florida both in May and in August. Finally, in large experimental plots of maize, weed species and overall community at the beginning of the growing season exhibited an aggregated pattern in more than 80% of the plots, while weed community displayed a random distribution in the other plots. The dominant species differed between treatments (cover crops vs. control), and displayed varied levels of aggregation. The aggregated spatial pattern may be attributed to vegetative reproduction, seed dispersal strategies, machinery activities or even within field local heterogeneity. These results from a wide range of agrosystems corroborates previous knowledge on the aggregated nature of weed distribution, and show that this pattern was consistent across various crops and seasons.

Keywords : Spatial pattern, SSWM, Patchiness

Beyond weed distribution maps

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Modern weed management approaches increasingly employ sensing technologies such as 3D cameras, multispectral imaging and artificial intelligence for weed detection and classification, in order to manage weeds through site-specific weed management (SSWM). Although weeds compete with the crop, they also provide ecosystem services such as maintaining and supporting pollinators and providing shelter for insects and animals. Knowing the morphological and functional characteristics (traits) of the weed species present in a field allows for the selection of SSWM methods that most effectively reduce the competitive ability of specific weed species while supporting species with beneficial functional characteristics. Therefore, trait-based approaches have gained popularity in recent decades. However, there is a gap in integrating and interpreting weed functional traits for practical applications, such as SSWM.

In this study, we aim to identify and assess weed functional traits related to both provisions of ecosystem services and crop competition and to translate knowledge on these traits into a map for potential risk and a map for potential benefits through biodiversity. These maps can form the basis for a field-specific weed management plan in the future. For this purpose, field experiments were conducted in 2022 near Braunschweig (Germany) on a winter wheat field untreated with herbicides. A grid of 40 sampling points (10 m x 6 m) was laid on the experimental field and a manual weed assessment was performed at each grid point. For each species a spatial distribution map was created using an ordinary kriging interpolation technique. Plant-specific functional traits relevant for the provision of ecosystem services and agro-ecosystem diversity (e.g. importance for insect families and species, birds, and duration of flowering) and crop competition (leaf dry matter content, leaf area per leaf dry matter, competition index, and plant height at the vegetative stage) were extracted from published datasets and combined into the two variables biodiversity and competition. Each variable was weighted for each pixel of the weed distribution map based on the occurrence and density of the weed species. Then a PCA was performed for each pixel of the grids to analyze the data using the biodiversity and competition variables. As a result, two maps were generated: one shows the areas in the field that have biodiversity benefits, and the other shows the areas where there is high competition potential due to weed composition. The goal is not only to reduce the application of herbicides but also to make a statement about the extent of ecosystem service provided by an agricultural field.

Keywords : SSWM, Traits, ecosystem services, weed mapping

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Biodiversity and weed control in railway networks: insights from a plant inventory

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Weed control in rail environment is essential to ensure safe and efficient train operation. The RATP Group (Régie Autonome des Transports Parisiens, Autonomous Parisian Transportation Administration) is a public transport operator and maintainer responsible for most of the public transport in the Île-de-France region (12 million passengers each day). Until May 2019, it exclusively used glyphosate for weed management on the 400 km of its railway network. Since then, the company stopped using chemical herbicides, making it imperative to find alternative solutions for weed management. Weeding requests from train drivers or service agents are more and more numerous since 2019. They are recorded and located along the railway each year. In 2021, a plant inventory was conducted to locate plant species across tracks and their surroundings, to find adapted solutions for weed management. 255 different species were identified across 394 releves. We characterized the weed communities according to their location around tracks and compared biodiversity indices on tracks and in their surroundings. Our results showed that weed communities were generally less diverse on tracks, but some species were adapted to both situations. We also found that certain plant species were associated with a higher number of weeding requests, likely due to their potential danger to train circulation. To better understand the characteristics of these species, we described their functional traits to link them with their possible effect on human activity and their reaction to environment. This knowledge is crucial to characterize species and communities that are associated to weeding request and the factors explaining the presence of these species. Our study presents important insights into the flora of the railway network to identify alternative solutions for weed management.

Keywords : Weed control ; Rail environment ; Glyphosate ; Biodiversity ; Functional traits

Quantifying the contribution of weeds to ecosystem (dis)services: from weed survey to proxy values

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Weeds are an essential component of the agroecosystem. They are one of the main biotic factors limiting crop productivity as they compete with the crop for available sunlight, water and nutrients. Their primary producer status also places them at the basis of the agroecosystem food web. The vast array of interactions weeds have with diverse biotic components found in cultivated fields can modulate ecological processes occurring in the above- and belowground parts of the agroecosystem. Several key issues need to be addressed in order to improve our ability to predict the potential services and disservices provided by weeds and to identify farming management options that could reconcile crop productivity and the provision of regulation services. Here, we present a framework developed to estimate, from weed survey conducted at seedling stage in the field core/margin (species identity, relative abundance), values of proxies quantifying potential weed harmfulness (competition, harvest difficulties and future weed infestations) and weed contributions to resources provision to pollinators (bees, bumblebees and hoverflies) and pest natural enemies (carabid beetles, birds and parasitoid wasps). These proxies are then used to assess the effect of farming strategies at the plot and landscape scale through a simulation study.

Keywords : indicator; ecosystem services; methodology; pest control; pollination; harmfulness

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An approach to add weed existence values in an economic threshold concept

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Weed economic thresholds are used to estimate the need for control. In this concept the threshold is reached when the cost of weeds exceeds the cost of controlling them. Costs caused by weeds account for yield losses, cleaning and drying, and technological harvest costs. Public interest rises in protecting biodiversity connected with agricultural land use. We started a project to extend the economic threshold concept for positive values of weeds on arable fields. Weeds in arable fields have e.g., a value as habitat and food source for insects and birds. Besides these services provided to the ecosystem ("ecosystem value"), weeds, as all organisms, have an existence value. No direct benefit is connected to the existence value. For the time being, we determine the existence value to be equal for all weed species. As a methodological example, we add the existence value to the current accounting for weed economic thresholds. We demonstrate the effect of different approaches to add the existence value. Further, we simulate how different existence values alter the economic threshold.

Keywords : threshold, biodiversity, existence value

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Vegetation survey methodology in segetal weeds is reported with differing degree of details depending on survey aims – literature review

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In a recent analysis of arable weed surveys, we found strong differences in species richness between observations originating from two scientific disciplines, weed science and phytosociology. We assumed the difference was caused at least partly by differing survey methodology. We could not conclude on this issue because of missing information on methodology in the dataset from phytosociology.

The overall aim of our current analysis is to illustrate differences and common methods between both disciplines or across various study aims. We conducted a literature search for publications studying weed vegetation with plot-based data. We limited our search to Europe but tried to cover all regions and the whole timespan of such vegetation research. From each publication, we retrieved (i) aims and goals, (ii) details of the study design (e.g., field selection), (iii) details of the practical execution (e.g., plot position and size), (iv) meta data (e.g., survey location and time spans), and (v) additional information on environment and field management collected in studies. According to their aims, we assigned studies to three categories: (a) phytosociology or syntaxonomy, (b) inventory or flora, or (c) analysis of the influencing factors.

The analysis of over 150 publications showed that almost all studies reported the species abundance measure they used, less so the plot sizes and surveying time (cca 80% and 65%, respectively), while only half reported on the plot position in relation to the field. The proportions differ between categories of study aims. Abundance measure is reported equally frequently in all categories. The other details are more frequently reported in studies interested in the influence of environmental and management factors on vegetation composition or richness, and least frequently in studies interested primarily in classification of plant communities.

Despite certain propositions in phytosociology to encourage the capture of relevant accompanying data for vegetation records across different vegetation types (in the field and/or during digitization), not all are consistently followed. It is expected that the use of large datasets to find general patterns in vegetation is going to continue and become increasingly complex in aims, questions, and types of analyses. For good compatibility and re-use of data, we therefore encourage future surveyors of weed vegetation to record and publish at least the following details with their survey data: plot size, plot positioning, recording date (or at least month), plant species abundance measure, and the crop or crop category.

Keywords : arable plants, agriculture, field edge, plot size, segetal plants, vegetation survey, weed

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Concept for a national weed monitoring in Germany

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The diversity of weed communities in Europe declines for many decades. Still, the knowledge about this diversity loss is very limited due to a lack of data on the spatial and regional status of weed diversity. This also applies to Germany where no monitoring data covering a wide range of crops and focusing on intensively managed cropping systems is available. Therefore, neither the status nor the future trend of the diversity of German weeds can be reported. Here, we present a concept for nationwide weed diversity monitoring. First, we estimated the necessary number of fields that need to be surveyed to sufficiently represent the national weed diversity. Second, we evaluated two approaches for the regional distribution of the monitoring fields in Germany. Third, we experimentally tested and selected the most efficient method to collect the necessary data on the field level. Fourth, we have chosen diversity profiles as a flexible and still very informative form of measuring and presenting data on national weed diversity. Given appropriate financial funding, this monitoring approach could provide reliable information on weed diversity for a central part of agricultural ecosystems.

Keywords : weed monitoring, weed survey

Species-area relationship in weed sampling of Finnish spring cereals

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Species-area relationship refers to the relationship between the number of species and the specific land area. Large area harbors more species than small area. In respect of weed sampling, this means that more species will be detected with larger sampling area. Here we studied species-area relationship in the sampling of weed communities of Finnish spring cereal fields. We proposed a question: how many more weed species will be detected by increasing the size of sample plot tenfold?

We used the data of the fifth survey of spring cereal fields, which was conducted at 16 regions, around 250 farms and 549 fields during 2020-2022. Both conventionally (N=459) and organically (N=90) cropped fields were included. Weed species were assessed from ten randomly placed sample plots per field in mid-July. Weeds were determined in a square measuring 1 m2 (1 m × 1 m) nested with 0.1 m2 (25 cm × 40 cm) rectangular frame.

Total number of weed species found in large sample plots was 139 and 115 in small plots. In conventionally grown fields the total species numbers were 125 vs. 106 and in organically grown fields 95 vs. 73 in large and small sample plots, respectively. The difference in species number per field was 4 species between small (10 species) and large sample plots (14 species). The same difference in species numbers was found both in organically grown (17 vs. 21) and in conventionally grown fields (9 vs. 13). As assumed, higher species number was detected by increasing sampling area. The results were consistent irrespective of cropping practices.

Keywords: sample area, sample size, weed monitoring, weed survey

Thermography – new method to identify weeds?

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With the computational power and lower prices of modern technologies, thermography is becoming more and more accessible in many sectors of human activity - agriculture is one of them. Thermography is a useful tool allowing instant remote insight into plant physiologic processes to help in the early detection of biotic and abiotic stress (e.g. plant diseases, water stress). Nevertheless, it was rarely used for plant presence or species identification until now. The work aimed to describe the thermal reflection response of 4 weed species (*Veronica persica*, *Tripleurospermum inodorum*, *Echinochloa crus-galli*, *Stellaria media*) under laboratory conditions (temperature 20±5°C, L:D 12:12). The thermograms of 20 plants of *Tripleurospermum inodorum*, *Echinochloa crus-galli*, *Stellaria media* and 10 plants of *Veronica persica* in a phenophase of the 2 true leaves were acquired by FLIR E6 thermal camera and analysed by FLIR Tool software. Our preliminary results suggest that the thermal reflection significantly varied between the species of weeds (Chisq= 16.098, Df=3, p= 0.001). The highest thermal reflection was found in the species *Echinochloa crus-galli*(20.1±0.501 °C).The lowest thermal reflection was found in the species *Tripleurospermum inodorum*(18.93±0.577 °C).The variance in the thermal reflection may be linked to the morphology of the leaves which depends on the taxonomical classification or explained through the physiological properties of each plant species. Therefore, there is a need to make other experiments to discern the variation in plants' thermal reflation and to calibrate the methodology of detection for the field condition. This method could help to detect weed plants in precision agriculture systems to geolocate management zones to apply appropriate measures.

Keywords : thermal imagining; plant; detection; temperature

Weed monitoring with citizen science data

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Weed monitoring can be a complicate task as it necessitates time and trained people. In the last years, citizen science projects that are available on web and mobile applications have been created to monitor organisms around the globe with the help of citizens. To explore the possibility of using citizen science to monitor weed presence in crop fields, a project called "Weeds of Italy" was created in 2020 by using iNaturalist and considering the observations already present in the database. Moreover, weed observations collected from different citizen science projects available on Global Biodiversity Information Facility (GBIF) website were downloaded for selected weeds (i.e. *Phytolacca americana*). Data containing weed observations from both iNaturalist and GBIF were imported as a shapefile in QGIS. Maps with weed data from GBIF were combined with data from CORINE Land Cover database having information on the soil use. Weed observations that fell within cultivated areas were selected to build distribution maps of weeds in arable fields. The project "Weeds of Italy" in January 2023 comprised of almost 38,000 observations of 87 weed species recorded by about 6,600 observers. The most recorded species were *Malva sylvestris*, with about 2,200 records, *Veronica persica*, *Phytolacca americana*, and *Papaver rhoeas*. The lowest number of observations was instead recorded for *Panicum miliaceum*, *Lolium rigidum*, *Phalaris paradoxa* and *Amaranthus tuberculatu*s, all having only about 10 observations since the start of the project. The activity carried out with the use of observations from citizen science projects, such as iNaturalist, appeared useful for identifying weeds but also to obtain weed distribution surveys. However, there are still some strong limitations such as the scarcity of observations of weed plants made in cultivated areas. In fact, most of the observations were in non-cropped areas and referred mainly to plants present in natural areas or on the roadsides; for example, only 35% of the observations of *Phytolacca americana* present in GBIF were in crop areas. Moreover, the species with many observations were those having visible and colored flowers and almost only very common and known plant species reached a high number of observations. The least observed species were instead those difficult to identify, less common and often pertaining to grass weeds with less showy flowers. The creation of specific citizen science projects on crop weeds, with observations also from agronomist and field technicians, will improve the possibility of using these tools in weed surveys.

Keywords : citizen science, weed mapping, weed survey

Perception of weeds and their ecosystem (dis)services by farmers, advisors, experimenters and researchers in France

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A national survey (1320 responses, 839 analyzed in this article, 56% of farmers, 26% of advisors, 14% of experimenters and 4% of researchers) assessed their perception of weeds. The positive effects of weeds are of less importance to the respondents than their negative effects. For negative effects, yield loss (direct harmfulness) and increase in seedbank (indirect harmfulness) are the most cited. Between 60% and 80% of the respondents consider that the negative effects of increasing costs of agricultural work and the loss of harvest quality are important. The positive effects "pollen source for insects" and "refuge for auxiliaries" are the most cited positive effect. The most cited problematic weeds were blackgrass (cited by 47.5%), ryegrass (45.3%), and Canada thistle (42.6%), wild oat (17.5%) and cleavers (16.2%). Twenty-two different virtual weed surveys varying according to different criteria were presented to the people surveyed, who had to indicate their perception of weed risk and their willingness to control such a community. There is a difference between the perception of the weed risk and their decision to control for farmers, experimenters, advisors, but not for researchers. There is a difference of perception within each type of actors, as big as between the actors. Different profiles, associated with their determinants, were identified.

Keywords : perception; farmers; harmfulness; ecosystem services; pollination; interview

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Relationships between plant species, earthworm abundance and soil physicochemical parameters in Swiss vineyards

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The impact of different soil management practices on vineyard ecosystem functioning has been studied to find sustainable alternatives to herbicides. The aim was to assess the relationships between plant communities, earthworm abundance and soil parameters under different inter-row vegetation management (i.e. spontaneous vegetation, winter cover crops and soil tillage). The role of earthworms in organic matter degradation, integration and soil decompaction is well known but rarely investigated in viticultural systems. Our study was conducted across a network of 18 vineyards of the Swiss Plateau in 2021 and 2022. We investigated plant cover and diversity, earthworm abundance and ecological groups and soil physicochemical parameters. We found strong relationships between specific grass species, soil characteristics and earthworm abundance, regardless of the management strategies. Earthworm abundance was negatively correlated with specific soil parameters, such as total copper concentration, soil bulk density (***) and the presence and thickness of a dense and undecomposed layer of organic matter (thatch) at the soil surface (**). The presence of the thatch at the soil surface was strongly correlated with the abundance of three grass species: *Lolium perenne*, *Lolium multiflorum* and *Poa pratensis* (***). These species are naturally present in Swiss vineyards and often sown as a permanent cover crop. These grasses have a vegetative dispersal, such as tufts and below-ground runners, that favours thatch formation. They can also generate a significant amount of organic residues (roots, leaves) that accumulate on the soil surface faster than the ability of the soil to degrade and integrate them. Moreover, they tolerate compacted soil and the presence of soil contaminants. We, therefore, hypothesized that compacted and/or contaminated soils with lower biological activity might synergistically enhance the abundance of the three above-mentioned grass species and the development of thatch, thus affecting key ecosystem services. Altogether, these results illustrate the potential negative impact of an unappropriated cover crop species selection on soil functioning. Further investigations are needed to understand the causal relationships between soil compaction, copper concentration, earthworm abundance and grass species. From a management point of view, winegrowers must be aware of the importance of cover crop species selection to avoid a decrease in soil biodiversity and the negative impact that this could have on soil functioning and vine health.

Keywords : Earthworms, vineyard management, biodiversity, soil functioning

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Deciphering the impact of agricultural practice and landscape structure on weed species diversity and selection of functional traits

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Arable plants provide important ecosystem services, e.g. being a nectar source for pollinators, preventing nutrients from leaching into ground and surface waters and protecting soils from wind and water erosion. In contrast, arable plants can also cause significant crop yield losses and other ecosystem disservices when they are allowed to thrive without appropriate management and which are then referred to as weeds.

This project aims to study the effect of agronomic practice and landscape structure on the abundance and diversity of arable plants in space and time. Moreover, it is the aim to develop a mechanistic understanding of the effects of agronomic practice and landscape structure on the abundance and diversity of arable plant functional traits and related ecosystem services and disservices. For this purpose, we are analysing data originating from the first nationwide inventory of arable plants in Sweden that was initiated in 2020 and that is being conducted during 2021-2023.

The inventory is based on a citizen-science approach where volunteer botanists are recruited and trained for the required field observations. For documentation and geo-referencing of species finds, the surveyors are provided with an online species documentation system. The inventory is divided into two parts: 1) A prioritised inventory of systematically spaced 2 × 2 km areas every 25 km across agricultural areas in Sweden for getting an unbiased and statistically solid representation of the abundance of arable plants. 2) A free inventory where surveyors randomly choose fields for capturing rare phenomena, such as rare arable plants and rare crops.

Volunteers are free to work according to either or both inventory methods, and are given a digital map showing the prioritised 2 × 2 km areas. For each surveyed agricultural field, a 100 m long and 1 m wide transect is chosen along the field edge as well as a second one perpendicular towards the center of the field. Each taxon of vascular plant is registered as well as the species abundance is estimated along each transect. The collected geo-referenced species abundance data will be merged with site-specific data on agronomic practice, agri-environmental payments as well as with data from the national geological survey and landscape information derived from satellite data showing land cover at a 10m resolution.

The results of this study will provide the basis for recommendations about agri-environmental schemes for promoting the transition towards productive agroecosystems that truly contribute to biodiversity restoration and harnessing of ecosystem services.

Keywords : citizen science, arable plants inventory, weed functinal traits

Acknowledgements : Swedish University of Agricultural Sciences

Factors influencing weed species composition in Hungarian phacelia fields

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Lacy or tansy phacelia (*Phacelia tanacetifolia*) a versatile cover, green manure and honey crop is now cultivated in many places worldwide. One of its principal European seed production regions is north-western Hungary. This study aims to assess the importance of three groups of factors: environment, non-chemical management, and chemical weed management, in determining the weed species composition of phacelia crops in north-western Hungary. We surveyed the weed flora of 205 fields across the region, along with 34 background variables. Applying a minimal adequate model consisting of 11 terms with significant net effects, 20.9% of the total variation in weed species data could be explained. The variation in species composition was determined by environmental factors (soil pH, clay and K content; precipitation and temperature), non-chemical management variables (crop cover, preceding crop, irrigation and tillage system) and herbicides (linuron and clopyralid). Variation partitioning demonstrated the dominance of environmental and cultural components on shaping the weed species composition. *Chenopodium album* was by far the most abundant weed. We also registered several rare, red list weed species (e.g. *Agrostemma githago*, *Anchusa arvensis*, *Centaurea cyanus*, *Galium tricornutum*, *Misopates orontium*, and *Neslia paniculata*) in extensively and organically managed phacelia fields during our survey. *Stachys annua*, a retreating melliferous weed with great ecological and historical value, sometimes thrived in large quantities in such fields. In contrast, the sprayed phacelia crops usually hosted only a few common weed species. Our findings highlight the importance of extensification in phacelia crops for the conservation of rare arable plants in Europe.

Keywords : arable fields, extensification, rare weeds, weed flora, weed vegetation

Service crops as a component in weed control interface for field crops

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Service crops (SC), also known as cover crops, are an essential and accepted element of sustainable agriculture worldwide. Service crops, defined as non-profit crops, are sown between one season's harvest and the next season's sowing as an alternative for fallow. Service crops have many benefits, such as improving soil structure, moderating soil temperature, increasing biodiversity, and reducing chemical runoff. We hypothesize that using service crops in a zero tillage interface can significantly reduce weed infestation in agricultural fields; moreover, the weed community composition will include more perennial species than annuals. Our study examines the potential benefit of SC for weed suppression. We compare conventional farming and alternative cropping system approaches, using SC in the winter season and zero tillage interface. Additionally, we compare the effect of organic additives (compost and semi-stabilizers cow manure) on weed suppression. The presented study was conducted within 2020-2022 in the model farm for sustainable agriculture at Neve Ya'ar Research Center. Vegetation surveys were conducted to examine weed population dynamics across time and different treatments. In the first year (2020), no significant effect of SC on weed coverage was observed. However, In the second and third years (2021 and 2022), a significant decrease in weed coverage within the SC plots was recorded. Differences in the weed field community composition in the first and third years were not significant comparing both treatments. In contrast, in the second year (2021), there was a clear difference in the community composition comparing SC and conventional farming plots. Examining the most dominant weeds over all three years in the SC plots, showed that the occurrence of *Amaranthus* species and *Cyperus rotundus* had decreased while that of *Convolvulus arvensis* and *Malva nicaeensis* increased. In the first year of the experiment, the general distribution of all weed species was random among plots. However, in the second and third years (2021, 2022), spatial distribution patterns show that most weeds were concentrated in conventional farming plots. The results show that SC affects weed communities' abundance, amount, composition, and spatial distribution patterns in agricultural areas. However, it is essential to note that the effect is complex, and not all weed species are affected similarly. This study highlights the benefits of using SC and the importance of further research to understand the complexity of this system in sustainable agriculture systems.

Keywords : service crops, GIS, weeds spatial analysis, GLMM, NMDS, sustainable agriculture.

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Effect of cover crops and tillage on the weed seedbank

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Increasing occurrence of herbicide resistant weeds in the Midwestern US creates a challenge for farmers to effectively manage weeds in commercial crop production systems. Therefore, integrated weed management (IWM) solutions are needed to reduce the reliance upon herbicides for weed control. To examine changes and differences in distribution and composition between individual species in the weed seedbank in response to IWM practices of cover crop rotations and tillage,a long-term field study was established in 2013 using a split-plot design with three crop rotation systems replicated three times: 1) *Zea Mays* L. (corn) – *Secale cereale* L. (cereal rye) – *Glycine max* (soybean) – *Vicia villosa* R. (hairy vetch) [CcrShv], 2) corn-cereal rye-soybean - *Avena sativa* L. (oats) + *Raphanus sativus* L. (radish) [CcrSor], and 3) corn - no cover crop-soybean-no cover crop [CncSnc], and two tillage treatments: conventional tillage and no-till. Seeding rates for *S. cereale*, *V. villosa*, and *A. sativa* + *R. sativus* were 87, 28, and 39 kg ha^{-1}, respectively. To assess the weed community present in the seedbank, two soil cores with a volume of 120 cm^3 were taken per sub-plot in the fall of 2019 after harvest. A soil grow-out was conducted in the greenhouse where emerged weeds were counted and identified, then removed from the sample. A total of 27 species were found in the weed seedbank. Permutational Multivariate Analysis of Variance (PERMANOVA) suggested an interactive effect of tillage and cropping system on the weed seedbank community. However, Permutational Analysis of Multivariate Dispersions (PERMDISP) suggested that there was also significant variability within the tillage treatments. Weed seedbank richness and diversity was higher in no-till systems as compared to tillage treatments. Systems with *V. villosa* had lower species richness than systems with *A. sativa* + *R. sativus* or no cover crop. Some species were differentially affected by tillage or crop, but there were no interactive effects of tillage and crop on any of the most abundant species. For the field-emerged weed community, a pairwise comparisons test suggested cover crop treatments have significantly lower weed richness compared to plots with no cover crop present, but there was no interactive effect of tillage. Three-way ANOVAs suggested time, tillage, and crop rotation influenced each weed species differently. An IWM program may maintain low levels of weed emergence and reduce seed credits to the seed bank; cropping systems that incorporate cover crops and tillage may alter the weed seedbank over time.

Climatic perspective to weed management- untangling the effects of local, management and climate factors on the infestation of Amaranthus species

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Determining the various factors affecting weed infestation in arable fields is complicated by the considerable spatiotemporal variability of agricultural systems. A possible solution lies in regional-scale studies of weeds in commercial fields to provide insights into the influence of field properties, climate, and weed management practices on the efficacy of weed management. The current study focused on Amaranthus species–noxious weeds infesting many crops worldwide–in processing tomato fields in Northern Israel, a region characterized by a sharp climatic gradient. This gradient provides an ideal opportunity to study the effect of climate on weed infestation and management. This study aimed to investigate the associations between Amaranthus infestations and local (field properties), climate, and management factors in processing tomato fields. A survey of 103 commercial tomato fields was carried out in 2018 and 2019 throughout the four major tomato-growing areas in Northern Israel:the semi-arid Beit-She'an Valley in the East (200-350 mm mean annual precipitation); the Jezreel Valley, stretching from East to West and gradually transitioning to a Mediterranean climate (350-600 mm); the Zevulun Valley in the West (500-700 mm) and the Hula Valley in the North (350-600 mm), both characterized by a Mediterranean climate. The spatiotemporal change in infestation for fields surveyed both pre- and post-weed control was evaluated relative to management and climate variables. A bootstrapped model selection for beta regression models with varying dispersion was performed to determine factors associated with weed infestation before and after weed management. The analysis showed that the application of sulfosulfuron pre-planting, could potentially reduce Amaranthus infestation depending on environmental and local conditions; management comprising of more intense control measures reduced infestation; and precipitation led to an increase in mean infestation when occurring before planting, but a decrease when occurring after weed management. Our findings show that management actions are key factors in controlling Amaranthus infestation but that these actions are affected by the local climate conditions. Overall, this study provides valuable insights into the factors contributing to *Amaranthus* infestations in processing tomato fields, which can contribute to more effective weed management practices. In addition, this work indicates the need for a regional-scale perspective when making weed management decisions, especially in light of climate change, which is expected to drive desertification processes in the eastern Mediterranean region.

Keywords : Beta regression; GLM; Regional-scale study; Weed Infestation

Acknowledgements : This research was funded by the Chief Scientist, Israel Ministry of Agriculture and Rural Development, grant number 132187417.

Incidence of species with reported herbicide resistance in Czech arable weed communities

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Arable weed communities are influenced by management factors, including herbicides. While repeated herbicide use over time could create a filter for certain species to slowly decline in the seedbank while others thrive, especially species that have developed herbicide resistance. As herbicide resistance becomes widespread it is important to document how community dynamics change in relation to management practices and also to consider the potential dominance of certain species which have resistant biotypes.

In this research, weed community diversity was analyzed from organic and conventional fields in the major production regions of the Czech Republic. Farms were selected based on farmer cooperation and were representative of the area. Of the species found throughout the survey area, species with recorded herbicide resistance in the Czech Republic and neighboring countries were highlighted.

Certain species with older recorded resistance in the Czech Republic were found to be associated with a particular production region, while species with newer recorded resistance were not particularly associated by region. Species with recorded resistance only in neighboring countries were mostly still found only in organic farms, indicating the success in controlling those species in the conventional fields. However, few species with reported resistant biotypes in neighboring countries were found in-season in conventional fields. Are these species unreported resistant in our country or are these species still able to be controlled? Herbicide resistance is a concern for profit loss by competition in season with the crop, but also may have long-term ramifications to the weed community in the seed bank even after management has changed. This analysis has provided a new landscape perspective to where herbicide resistant species may be without waiting for individual farmers for cases of herbicide failure.

Keywords : conventional farming, PS II inhibitors, ALS and ACCase inhibitors, altitude

Quantification of the contribution of weed seed predators to crop yield

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There is increasing empirical evidence of a regulatory effect of seed predation on weed dynamics, and notably on the evolution of the weed seed bank from one year to the next. In parallel, exposure experiments show that weed seed predators can reduce weed emergence but such studies remain extremely scarce. Besides, these experiments do not assess the contribution of seed predation to crop productivity. In order to get a proper quantification of the contribution of weed seed predators to the biomass of a large range of weed species and to the resulting crop productivity, we set up a large experiment with different modalities of predators exclosure in 30 commercial winter cereal fields in Burgundy, France. In each field, we installed four 30 by 30 cm wooden boxes containing sterile soil, the boxes were buried so that the top of the box was at the soil surface. We then placed 216 weed seeds of nine common annual weed species and 20 wheat seeds. The three exclosure modalities were as follows (i) access to all predators, (ii) access to invertebrate predators, (iii) no access to predators. A fourth modality comprised wheat crop but no weeds to assess the "maximum crop productivity potential". Weed seeds were sowed in May-June 2021 during natural weed shedding while wheat seeds were sowed in October 2021 when farmers did it. We surveyed weed and wheat growth in each box from the sowing date to wheat harvest in July 2022. We showed that crop productivity is reduced by 80% when weeds were not predated in comparison to the maximum crop productivity potential; while it was reduced by 58% when all the seed predators consumed weed seeds. Considering absolute values, seed predators doubled crop productivity via weed biomass reduction. Moreover, when only invertebrate predators accessed to weed seeds, crop productivity was reduced by 46% confirming what vertebrate predators have also negative effects on crop productivity. Our study is the first to quantify the efficacy of weed seed predators with respect to crop productivity.

Keywords : Seed predation, carabids, field experiment, weed control, crop productivity

Acknowledgements : This work was supported by the European Partnership in Innovation EIP-Agri project RegGAE Biological Regulations in Arable farming funded by the EU Rural development 2014-2020 for Operational Groups and the Conseil Régional de Bourgogne

Comparing seed predation in a native prairie patch with surrounding pulse crop fields

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Carabid beetles are thought to contribute to the biocontrol of pests and weeds in agricultural fields and as such, their conservation within a landscape is desirable. Fragmentation of the agricultural landscape can reduce populations of carabids and thus, the beneficial ecosystem services they provide. In Canada, remnant native prairie (undisturbed) patches may provide an important refuge for carabids within an otherwise unsuitable cropped landscape. Here, we studied how predation in a remnant prairie patch compared with that observed in nearby pulse crop fields. We sampled carabid beetles and quantified seed removal of volunteer canola (*Brassica napus* L.) and kochia (*Bassia scoparia* L.) across 24 large commercial fields of lentil, field pea, faba bean, chickpea and compared them with a 130 ha native prairie patch in Saskatchewan, Canada. Seed removal was assessed using seed cards within exclosure cages, while carabids were sampled using pitfall traps. We also explored the relationship between carabid activity-density and weed seed predation in these two contrasting habitats. The proportion of the seed consumed varied between habitats over time. Seed predation was highest earlier in the season (mid-May) in pulse crop fields, while seed predation peaked mid-season (late-July) in the native prairie. Carabids generally consumed more kochia (27%) than volunteer canola (19%) in the native prairie, but consumption of these species in pulse crop fields changed over time. Relationships between carabid genera and seed predation also differed between habitats. Carabid activity density tended to be positively related to seed predation in cropped fields, while the reverse was true in the prairie. While non-crop habitats are known to harbour diverse carabid communities, our results suggest that these communities also differ in seed predation dynamics.

Keywords : carabid, seed predation, seed seedbank

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Distribution of the weed flora in a small agricultural landscape

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Within a small agricultural landscape, the spontaneous flora present in cultivated areas is not homogeneously distributed. Within the same crop type, the floristic composition varies according to the type of agricultural management, for example conventional vs. organic farming. Moreover, within a same field, the floristic composition varies according to the in-field location, namely the field core, the field edge (zone where the soil is worked but without cultivation) and the perenial field margin.

In this study, we analyzed the flora of wheat fields located in a small landscape in the surrounding of Dijon in 2021-2022. We selected three wheat fields in each of three types of farming systems; conventional agriculture, organic agriculture and conservation agriculture. In each of these nine fields, flora surveys were conducted at four times of the year (November, February, April and May). In the field core , the flora was surveyed with abundance class scores (Barralis, 1976) along a W-shaped path on a 40m x 50m rectangle. In addition, the presence/absence of flora was recorded along a 50m transect parallel to the rectangle in the field edge and in the field margin. In total, we recorded 161 plant species. In the field core, we identified 72 species, and floristic richness and diversity were higher in organic (47 species) and conservation agriculture (41 species) than in conventional agriculture (26 species). In terms of composition, more biennial or perennial species were found in the conservation agriculture fields than in the other systems. In addition, the edges and margins of the organic fields were richer (71 and 99 species) than those of the conservation agriculture (64 and 78 species) or conventional agriculture (62 and 77 species) plots. Our study confirms that the spontaneous flora of wheat fields can be highly variable under contrasted farming systems and in-field locations. It also highlights that organic fields highly contribute to plant diversity at the landscape level.

Keywords: spontaneous flora / floristic richness / farming systems / field / field edge / perenial field margin

Acknowledgements : We thank INRAE for their financial support and all the farmers from the study site for granting access to their fields.

Surveys on weeds in spring cereals fields in Finland

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Spring cereals cover about 50% of the cultivated area in Finland. The weed flora in spring cereals has been investigated in Finland since the early 1960's and repeated now for a fifth time during 2020-2022. The occurrence of weed species has been assessed from ten randomly placed sample quadrats per field in mid-July. The main objective has been to discover the composition of weed flora in different decades and thereby support the weed management efforts. Moreover, biodiversity role of weed species has been emphasized and linked to the targets and measures of agri-environmental support schemes. The number of observed weed species was 309 in the 1960's and has gradually decreased down to 139 in the latest survey. There has been a substantial change in weed species composition in terms of the most common and abundant weeds species. This has been an adverse trend for weeds as source of nutrition for farmland birds and pollinating insects as described by an agro-biodiversity indicator based on trophic interactions between 25 common arable weeds and individual groups of farmland birds, pollinators (wild bees), phytophagous insects and insect pests. Changes in the intensity of agricultural practices have been regarded as drivers of weed shift. Representing less intensive cropping, organically cropped fields have been included in the weed surveys since the 1990's. The current frequency of the most common species differs between production types; *Chenopodium album*, *Erysimum cheiranthoides* and *Viola arvensis* being the most common ones in organically cropped fields and *V. arvensis*, *Stellaria media* and *Galium spurium* in conventional fields. As a newcomer in the list of most frequent weed species, *Poa annua* can be regarded as one of the indicator species for conventional production because it was found from 47% of conventional fields but only from 11% of organic fields. This Poster will be presented as a supplementary material for the oral presentation of findings from our series of weed surveys.

Keywords : biodiversity, organic farming, Poa annua, weed shift

Evaluation of the impact of aerobic and flooded rice cultivation on weed flora composition in Iran

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Weed biodiversity plays a significant role in maintaining the processes and functions of ecosystems. Weed biodiversity is affected by many factors like climate change, herbicide application and cultivation methods. In this study two methods of rice production (aerobic and flooded) considered to detect the variation of weed flora. Literature review from more than 30 documents of thesis and papers which done in rice production areas in Iran, especially in the Northern of Iran was done to gather information. The number of species, families, their density, frequency and uniqueness were evaluated. The result showed the significant difference between two methods of rice cultivation. The number of species and families increased in aerobic rice cultivation. In aerobic rice cultivation the rate of broad-leaf weeds had increasing rate than to flooded method. *Cyperus difformis* was highest rank in both methods of cultivation, while in flooded method the numbers of aquatic weeds were higher than aerobic method. Weed density, frequency and uniqueness had significant difference in the two methods.

Keywords : Biodiversity, rice cultivation, weed frequency, weed uniqueness.

Acknowledgements : University of Gorgan agricultural sciences and natural resources, Gorgan, Iran

The effects of site-specific environmental conditions on weed species composition in small-scale vineyards in Serbia (SE Europe)

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Management regime plays a critical role in defining the vineyard weed composition and diversity. While the impact of management practices has been extensively studied, studies focusing solely on site-specific environmental effects on vineyard weed diversity are generally rare and non-existent for SE Europe. Given the proximity and similar management regimes of the studied field sites, our aim was to test whether site-specific environmental conditions and local micro-site differences affect the composition of vineyard weed communities.

Field research was carried out at three small-scale vineyards in the same geographical area (Vršac, NE Serbia). The study design followed the nested sampling structure. Four blocks were randomly chosen at each vineyard, and four permanent 1 m^2plots (two at the row edge and two in the row center) were placed in each block. Weeds were determined to the species level and counted within each of the 48 plots. Multivariate analyses were used to show how weed composition varies in relation to site-specific parameters. Two separate canonical correspondence (CCA), a principal component (PCA) and three redundancy analyses (RDA) were done using software CANOCO 5.0.

CCA analysis has shown a statistically significant delineation in the weed flora between the three studied vineyard sites. PCA and RDA analyses have illustrated the strong filtering effect of site-specific environmental conditions (row spacing, soil type and site-specific landscape characteristics) on the presence of different life forms and phenological groups of weed species. In addition, a separate CCA has shown that micro-site conditions (i.e. at the block level within the same vineyard) also lead to differences in weed community composition, resulting in the dominance of certain weed species in different sections of each of the analyzed small-scale vineyards.

Keywords : vineyard; site-specific environmental conditions; micro-site conditions; weed flora; Serbia

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Management of *Lupinus polyphyllus* to restore the habitat for *Knautia arvensis*

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Andrena hattorfiana (large scabious mining bee) is a critically endangered pollinator species in Norway and elsewhere in Europe. The species is oligolectic and strongly dependent on the scabious flowers, especially the field scabious (*Knautia arvensis*) that ensures the pollen source for it. The drastic decline in the number of *K. arvensis* plants in Norway due to the invasion of invasive plant species such as *Lupinus polyphyllus* (garden lupin) is one of the main reasons for declining the number of this bee species. Therefore, several management attempts are being considered for removing invasive plant species and restoring the habitat for *K. arvensis* and consequently for *A. hattorfiana*. In 2022, a pilot study has been done in the southern part of Norway, Grimstad, to assess different control methods against *L. polyphyllus* in an invaded area with the lowest effect on native species. Three methods were tested: 1) two times cutting down of plants as low as possible in June and August using a grass trimmer, 2) one time cutting down of plants in June followed by spot spraying of plants with glyphosate (6 l/ha) in August, and 3) digging out of the plants in June. It was shown that the best control results were obtained by cutting down plants followed by glyphosate application following the regrowth. Digging out of the plants was the most demanding and time-consuming method and it was not successful in terms of taking out all the root system for some of the plants. These methods have been tested for one year and should be repeated. Other control methods and restoration plans are under consideration.

Keywords : Endangered species; Habitat restoration; Invasive plant species

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Past and present weed vegetation at Ljubljansko barje area, Slovenia: preliminary results

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Ljubljansko barje area in Slovenia is well known Late Neolithic to Early Bronze Age archaeological wetland site, where more than 40 pile-dwelling settlements have been discovered. Besides the remains of cultivated and intentionally gathered plants, seeds/fruits of other plant taxa from the surrounding area can also be recovered. Weeds are important, but usually get less attention than cultivated species in archaeological research. The variety of weed species that occur in fields depends, among other factors, on the crop and field management. The presence or absence of certain species can give us information about agricultural practices, which becomes important when researching the beginnings of agriculture and farming practices in the past. We aim to apply a multi-faceted approach to study past and present weed vegetation of the Ljubljansko barje, including (i) soil seed bank analysis, (ii) recording standing weed vegetation, (iii) utilizing an existing vegetation plot database, and (iv) compiling archaeological records of herb species. According to the preliminary results, we report that the most frequently found seeds/fruits in the soils of the recent field were from the taxa of the genus *Chenopodium* and family Poaceae, mainly from the genera *Festuca*, *Lolium*, *Setaria*, and *Echinochloa*. Some of the taxa were detected in both, recent and archaeological samples, such as species from the genera *Chenopodium*, *Rumex*, *Trifolium*, and *Stellaria*, while the others are totally absent or present with individual specimens. With further research, we hope to elucidate species' roles as either weed, ruderal, or even cultivated species in the present and past.

Keywords : soil seed bank, archaeobotany, weed vegetation, agricultural practices

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Can conservation agriculture deeply change the structure of weed communities?

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Weed communities in cultivated plots are characterised by a high proportion of annual plants (therophyte) with a seedbank that plays a central role in the dynamics of these species. This characteristic can be considered an adaptation to soil tillage, which is a major disturbance for this plant community. Conservation agriculture has been identified as one of the farming systems likely to deliver sustainable agriculture. However, the cessation of soil tillage, which is one of the bases of this farming system, together with the establishment of the most complete soil cover (plant or dead mulch), raises the question of what will happen to the weed communities in terms of their composition and function. In 2018 and 2019, using networks of 120 winter wheat and soyabean fields selected to encompass a gradient of years in CA (1 to 20 years), the changes that occurred in the diversity of weed communities were analysed over several years. For each field, weed communities were surveyed on a 50 × 40 m area. Weed data were collected during two years at three periods: in early March, in mid-June and in early September during the intercropping period. On all plots, 262 weed species were observed. On the winter wheat plots, the observed species richness varied greatly - from 6 to 69. The species richness increased significantly with the number of years under CA, from an average of 19.2 to an average of 23.9 species (± 12.7). The adoption of conservation agriculture seems, after about ten years, favour a homogenisation (*P <0.05), of the weed communities. Some new species from the field borders can be observed in the fields and an increase in the presence of common weed species (perennial broadleaves and grasses) can be observed over time. In the soil and climatic conditions of our study, and despite the significant use of synthetic herbicides, it does not seem that conservation agriculture can be held responsible for the decrease in the diversity of weed communities, even if further studies are needed to determine, for example, the status of so-called segetal species.

Keywords : No-tillage, life forms, diversity, field plant community

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Incidence of thermophilic, grass and rare arable weeds in cereal fields in the Czech and Slovak Republic

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The Czech Republic and Slovak Republic, while currently independent, have a common historical development which has been reflected in agriculture and weed communities. The three-year phytocoenological survey was conducted from 2006 to 2008 in five climatic regions and eight different soil types. In total, 379 relevés were recorded and 281 weed species were found. Our objectives were to characterize arable weeds of the Czech and Slovak Republic in cereals, especially considering important groups of species: thermophilic, weedy grasses, and the rare and endangered species. The effects of both climatic region and soil type were found to be statistically significant. Species richness increased with altitude. Several species were distinctly associated with soil type from fertile chernozems to less fertile cambisols, while fluvisols only had a strong association with *Calystegia sepium* (L.) R. Br. The incidence of species outside of their expected regions generally fit two categories: the most pervasive weeds found in all climate regions such as *Echinochloa crus-galli* (L.) P. Beauv., or rare weeds in higher altitudes than expected, such as *Lolium temulentum* L. Rare and endangered species were more likely to be found in colder climate and poorer soils and this could be linked to less intensive management, however, not all endangered arable species can tolerate such conditions. Even though this data is not recently collected, this is still valuable information on the distribution of weedy species, especially concerning the current interest in maintaining biodiversity.

Keywords : Czech Republic; Slovak Republic; phytocoenological relevés; altitude; climatic regions; weedy grasses; endangered species

Noxious weed species in sugar beet stands in the Czech Republic

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Sugar beet (*Beta vulgaris* subsp. *vulgaris* var. *altissima*) as a wide row crop is highly sensitive to weed infestation, showing low competitive ability to weeds in early growth stages. Weed management in sugar beet stands is intensive, repeated applications of mostly contact herbicides are used. Nevertheless, weed management is not always efficient enough so that weeds can survive and occur in the stands till the harvest time, producing seeds and increasing soil seed bank. In 2021 we monitored sugar beet fields to investigate which weed species are the most important in the second half of the vegetation period. We classified weed species occurrence intensity into 4 groups, where 0 = no visible weed individuals; 1 = 1-10 indiv. per ha; 2 = 10-100 indiv. per ha; 3 = more than 100 indiv. per ha.In total, 122 fields with sugar beet were visited during August – September in central and eastern Bohemia region. 75 % of the fields were without significant weed infestation. 19 % were classified as medium infested and 6 % as heavily infested with weeds. In those 25 % of the fields with more intensive weed occurrence 10.6 % were infested with *Chenopodium album*. This species was classified as the most important one. Volunteer oilseed rape (*Brassica napus*) was found in 6.6 % of the fields. Weed beet *(Beta vulgaris*, annual forms) occurred with higher intensity in 5.7 % of sugar beet stands. The most important grass weed was *Echinochloa crus-galli,* which was found in 4.1 % of the fields. 2.5 % of the fields were infested by *Amaranthus retroflexus* and *Persicaria lapathifolia*. *Tripleurospermum inodorum, Cirsium arvense, Avena fatua, Abutilon theophrastii*, and *Helianthus annuus* (volunteer sunflower) were found in 1 % of the fields. We can conclude that most of the farmers are able to control weeds in sugar beet stands so the weeds can not affect crop yield. *Chenopodium album*, weed beet and volunteer rape are those species that can occur with higher intensity and weed management practices should be focused on them.

Keywords : sugar beet; weed infestation; *Chenopodium album*; weed beet.

Biodiversity of weeds among horticultural Crop Wild Relatives in Poland

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The flora of Polish vascular plants is estimated at approximately 3500 species (including alien plants), 1458 of which are considered as Crop Wild Relatives (CWR). Some of the species from this group of plants are segetal and ruderal plants occurring in agricultural fields and their edges, therefore their richness and diversity is highly appreciated. This group of plants which has a positive significance (usefulness) in agrocenoses, they are mutually dependent on other living organisms inhabiting the same ecological system (agricultural lands) and are related to cultivated plants. On the Polish list of CWR, there are 213 segetal and ruderal taxa that are considered significant in agrocenoses. The majority of them occur in fields, orchards, gardens or their edges, often crossing from xerothermic grasslands or meadows located near fields. Another group of these species occur in ruderal habitats throughout the agroecosytem. Among the 213 aforementioned species occurring in agrocenoses, almost half (97 taxa) also belong to the group of medicinal plants, 152 to the group of edible plants, 85 to the group of cosmetic plants, 75 to the ornamental group of plants, 61 to the fibrous and dyeing group, and 30 to the group of forage plants. This shows the diverse utility of taxa of segetal and ruderal plants. Among them, 24 appear on the European red list of vascular plants and 38 on the European red list of medicinal plants. In contrast, the Polish red list of vascular plants contains 51 species, whereas the Polish red book of plants contains a further 12. About 77% of those species can be found in *ex situ* collections of botanical gardens and arboreta. However, in gene banks this number stands at around 42%, predominating in single samples in the form of seeds or in field collections. In the face of the extinction of these species and of progressive monoculture, the best way to save these endangered wild species is to maintain the currently existing biodiversity in agrocenoses (*in situ*). This vegetation should be noted, appreciated and preserved in order to achieve balance in agrocenoses, without any predominating species. These plants have notable potential and they may likely be of extreme value in the future.

Comparing vegetation in new and old field boundaries: how important are weeds?

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Field boundary establishment and conservation has been supported with Environmental Schemes during decades in several European countries and right now, the new CAP 2023-27 supports the creation of margins (>2m wide and >25m long). A possible drawback of this ecoregime is the possible growth of weeds in these margins and a subsequent spread towards adjacent fields. Thus, a balance between biodiversity restoration and weed infestation needs to be found impeding that these structures harbor non-desired species.

This work presents data of (1) a long-term experiment with newly-established boundaries next to organically-managed fields (NB), (2) old boundaries in conventional farms (CB) (both of them surveyed previously, other data of those boundaries published in Cirujeda et al., 2022) and 3) old boundaries in an organic farm (OB) surveyed in 2022-23, all of them located in Zuera (Zaragoza, Spain) in a semi-arid cereal monocrop environment.

In all cases, each single weed species was recorded and percent ground cover recorded in spring. Concerning NB, 8 m wide strips set-aside in different years aged between 0 and 10 years were sampled in four 2 x 2 m quadrats per margin. CBs were sampled in three rectangles as wide as the margin and 2 m in length with 2.2 m mean width. These boundaries had been periodically receiving herbicide and fertilizer drift from the surrounding fields. In 2023, OBs were sampled; vegetation growing in these boundaries had not received fertilizer or herbicide drift since more than 20 years. Each boundary measured an average of 34 m length and 2.9 m mean width and plants of the whole margin surface were accounted.

Results of the NB showed that plant soil cover increased very rapidly and reached a stable tendency 3-4 years after establishment (Cirujeda et al., 2022). Thus, for this study we chose only NBs aged 4 to 10 years. Mean number of total species and weed species as well as their cover were accounted in all margins, ANOVA and mean separation tests were performed.

Weed species number per boundary was found to be very similar between all the different boundaries ranging between 5.6 and 8.9. The percentage of weed species on the total plant species was found to be highest in CB (43.2%) and lowest for 8 year-old NB (28.9%) without significant differences. Weed ground cover was <5% in all cases demonstrating a relatively low weed infestation in any of the sampled boundaries.

Keywords : agro-environmental schemes, ecoregimes, richness, weed ground cover.

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Weed and soil microbiome diversities effects on wheat yield under two management systems

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In this work, we aimed to explore the relationship between crop management scheme (organic or conventional), weed abundance and diversity, the diversity of soil microbiome and crop yield in wheat fields of Mediterranean Spain. A thorough evaluation of these relationships is still lacking, but its assessment could favour management recommendations aimed to optimize crop yields while maintaining soil health, weed diversity and its potential ecosystem services. On 2020-2021 field season, we selected 6 wheat pairs of fields. Each pair consisted of one organic and one conventional field, with similar soil characteristics and within the same landscape. At the beginning of wheat stem elongation stage, we randomly placed 14 quadrats (1 m^2) in each field, which we maintained till harvest. Four of them were kept free of weed vegetation throughout the growth season. At wheat flowering stage, we recorded the cover of weeds per species in the "weedy" quadrats. We also took a sample of soil in each quadrat from which we obtained the abundance of distinct Amplicon Sequence Variants (ASV) for bacteria. Before crop harvest by the farmer, we clipped the wheat in all quadrats. In each weedy quadrat, we obtained the diversity ($e^{H'}$) of weed communities and of bacteria ASV (resolved to genus), as well as a measure of relative crop yield (ratio of crop yield in the weedy quadrat to the average crop yield of weed-free quadrats in each field). We analysed the effects of weed cover, weed diversity, bacterial diversity and crop management on crop yields by means of Generalized Linear Mixed Effects Models. There was not an effect of bacteria diversity or weed cover on crop relative yield, whereas there was an interaction between crop management and weed diversity (Estimate=0.02; Chi-square=3.9 df=1 p=0.045). Higher weed diversity was associated with higher values of relative crop yield in fields with an organic management, but not in conventionally managed fields. The same pattern was found when analysing the absolute crop yield, though in this case we did not find statistical differences. Our results show that the effect of weeds on crop may differ between crop management schemes and that maintaining weed diversity may not compromise crop yields. We also found that the diversity of the whole bacterial microbiome may not be a good indicator of plant-soil interactions and that we may need to differentiate between the diversity of bacterial functional groups.

Keywords : biodiversity; bacterial ASV; Mediterranean cereal systems; organic management

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