Comparison between urban and arable populations of rattail fescue (*Vulpia myuros*)

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BCPC Weed Review, NIAB, 31st of October 2024

Introduction

- *Vulpia myuros* or rattail fescue
- Poaceae (grass family), close to Festuca and Lolium species
- slender and smallish 5-50 cm
- identification at vegetative stage is difficult

Stéphane Cordeau © INRAE 2020

Introduction

- at vegetative stage, *V. myuros* can be mistaken for other grass weeds, especially *Festuca rubra* and *Lolium perenne*

	Rat's tail fescue	Squirrel-tail fescue	Red fescue	Perennial ryegrass
Characteristics	***Vulpia myuros***	***Vulpia bromoides***	***Festuca rubra***	***Lollium perenne***
life cycle	annual	annual	perennial	perennial
root system	fibrous, no rhizome	fibrous, no rhizome	rhizome	no rhizome
auricle	absent	absent	absent	small if present
ligule	short, 0.2-0.4 mm	short, 0.2-0.4 mm	short, <0.5 mm	~1-2 mm
leaf blade	hairs on veins	hairs on veins	glabrous	glabrous
leaf sheet	split		not split	
inflorescence:				
general form	very contracted, linear	contracted to open	contracted to open	contracted to open
uppermost leaf sheet	**enveloping panicle base**	**not enveloping**	not enveloping	not enveloping
glume length	**upper g. >> 2x lower g.**	**upper g. < 2x lower g.**	upper g. < 2x lower g.	
terminal awn	5-15 mm long	5-15 mm long	0.7-3 mm long	absent

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©UK wildflowers

©Thomas Mathis

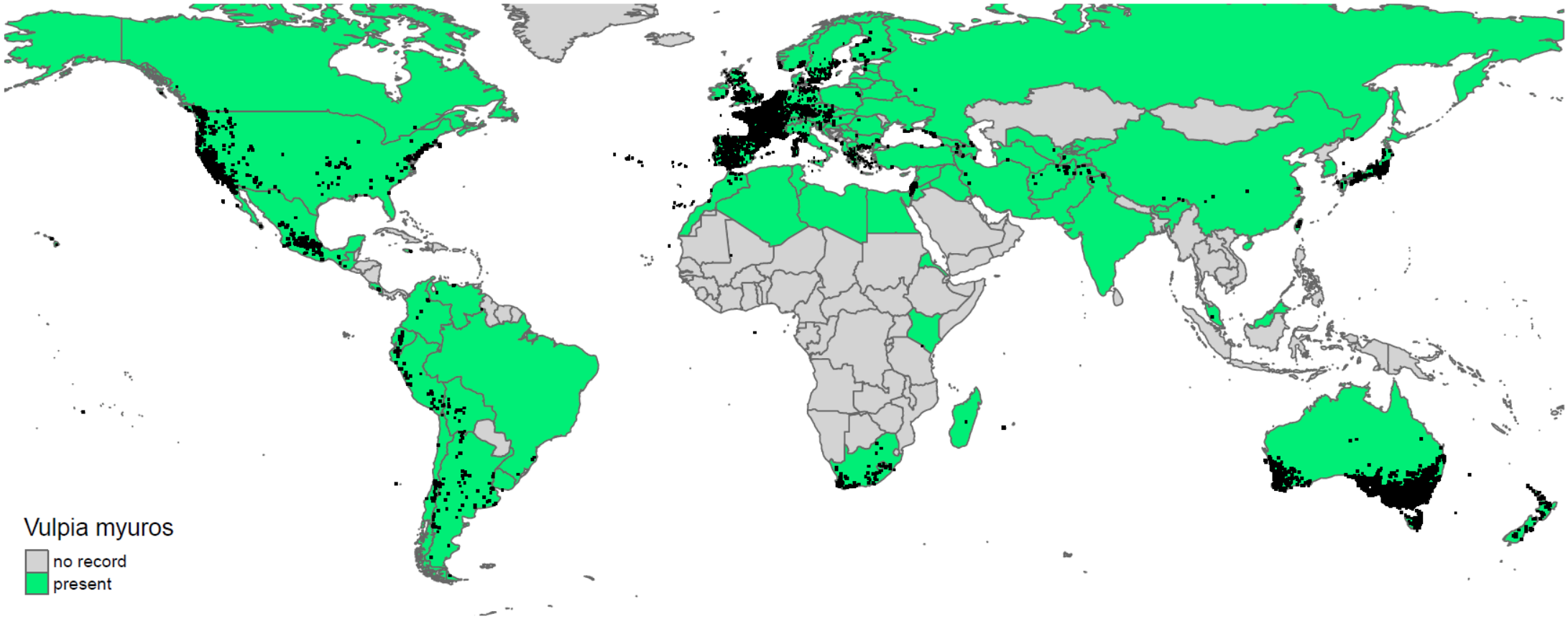
©Arthur Chapman

Introduction

- mainly self-pollinating
- produce numerous small seeds with long awns
- 4,000-22,000 seeds per plant without competition

Introduction

- Mediterranean origin with global distribution
- introduction through human settlements in Australia and California



Büchi et al., 2021, Weed Research 61:13-247

Introduction

- huge problem in pastures in Australia and New Zealand
- more and more reported as a weed in the US and in Europe, e.g. Denmark, France, Spain, UK
- also present as a weed in urban spaces in Europe

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- winter annual, germinates in autumn, flowers in spring and shed seeds in summer
- problematic in winter crops in reduced tillage systems

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- suboptimal control by glyphosate, naturally tolerant to ACCase inhibitors (‘fops’ and ‘dims’)
- pre-emergence herbicides are more effective than post-emergence
- cultural control: tillage, spring crops, stale seed beds, delayed crop sowing

Introduction

Introduction

Introduction

culture has followed after cereal crops. Pictures taken in October on these lands show the degree of invasion by *Vulpia myuros* plants (Figure 1, 2).

Figure 1. Overview of rape field

Figure 2. The invasion of *Vulpia myuros* plants in rape crops

The infestation degree was not reduced by herbicides applied, e.g. Prosper or Agil 100 EC, the last in a dose of 2.5 l/ha.

As in the previous cases, *Vulpia myuros* infestation was observed early as autumn. Spring the herbicide Pulsar 40 application have no effect on *Vulpia* plants. The appearance of the rapeseed crop in June can be seen in Fig.3 and 4.

Figure 3. Rapeseed field in June in Mihăileşti town

Figure 4. *Vulpia myuros* and rape plants

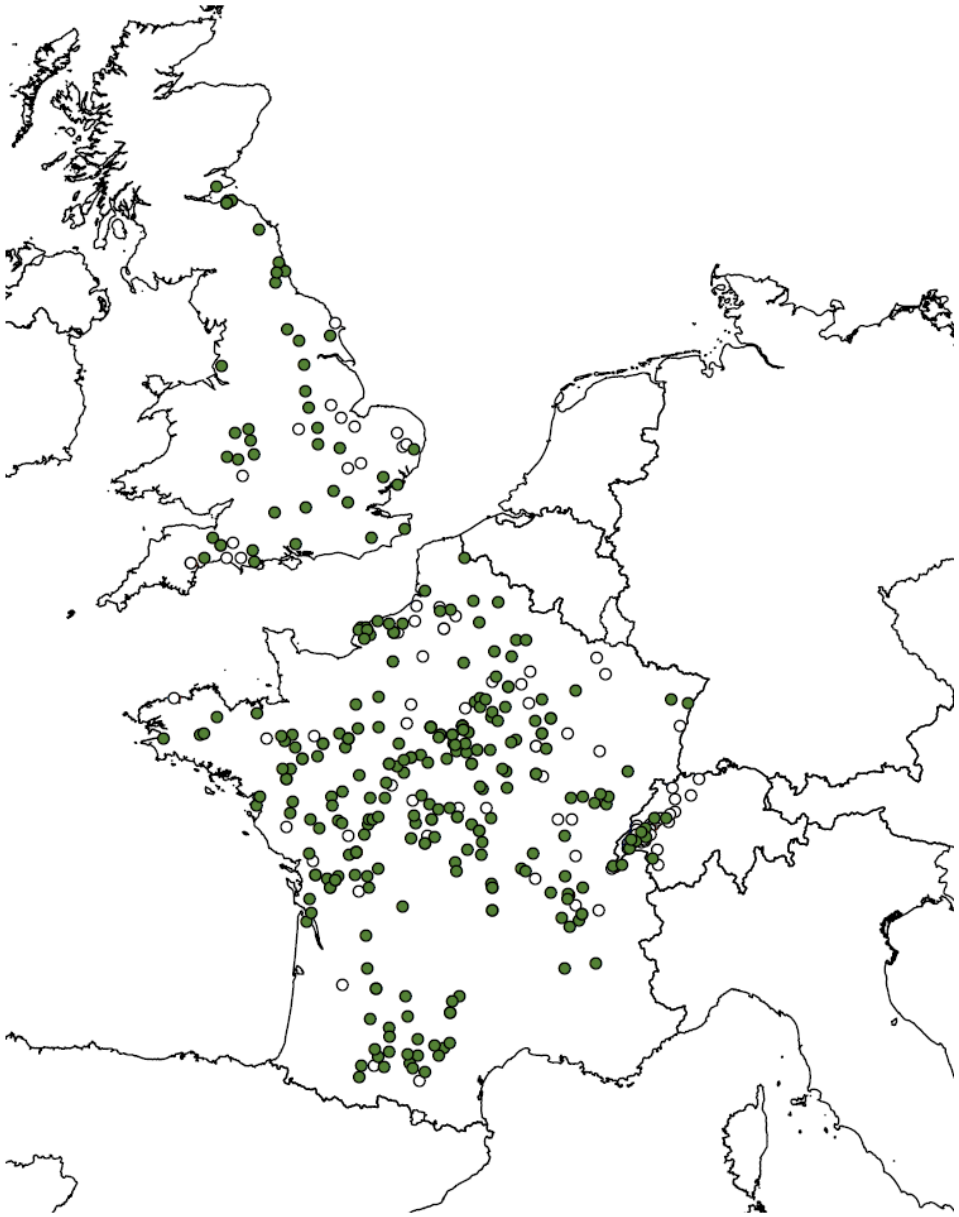
Georgescu et al., 2016

Projects

- online survey launched in 2021, mainly in the UK and France, asking about *V. myuros* presence and associated cropping practices

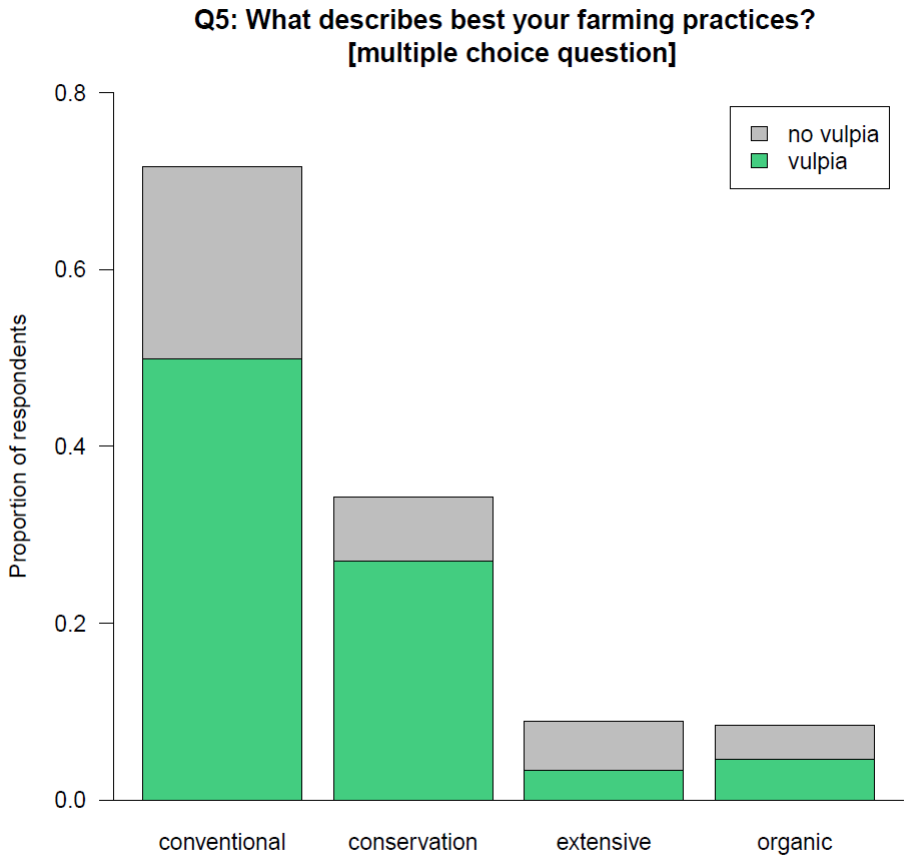
- field work in summer 2023 to collect seeds from arable and ‘wild’ populations to compare their characteristics: getting a better understanding of the origin of weed populations
- only ‘wild’ populations found were in urban areas, no populations found in grasslands

Survey

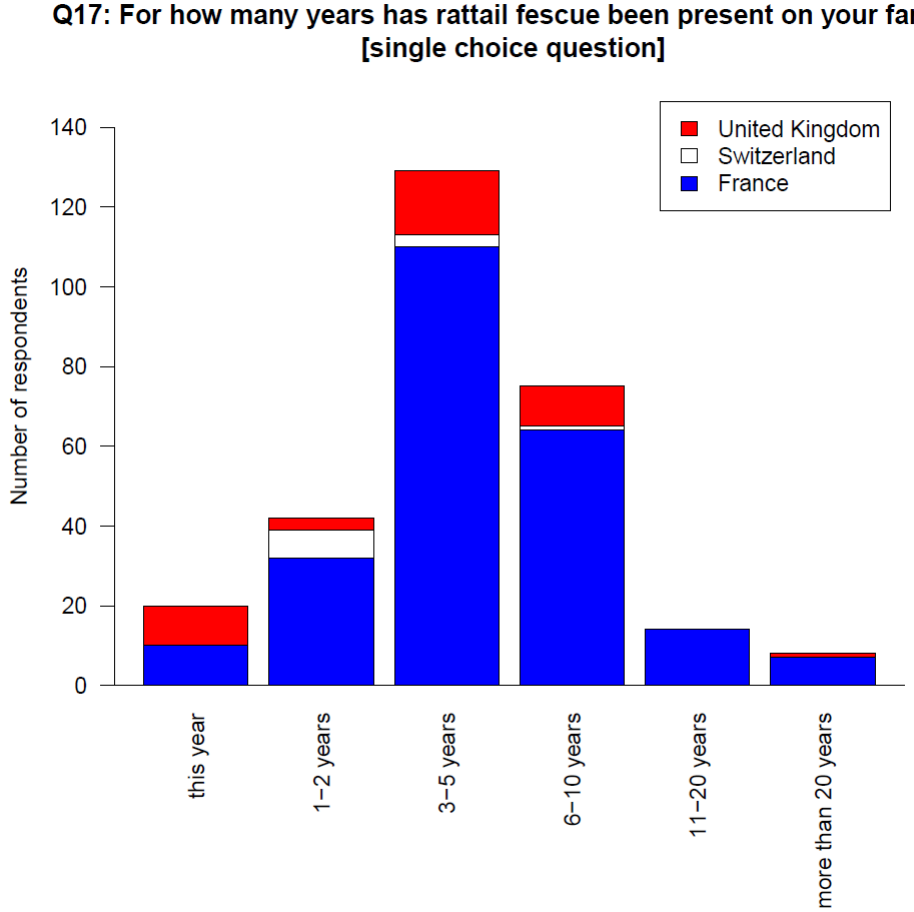


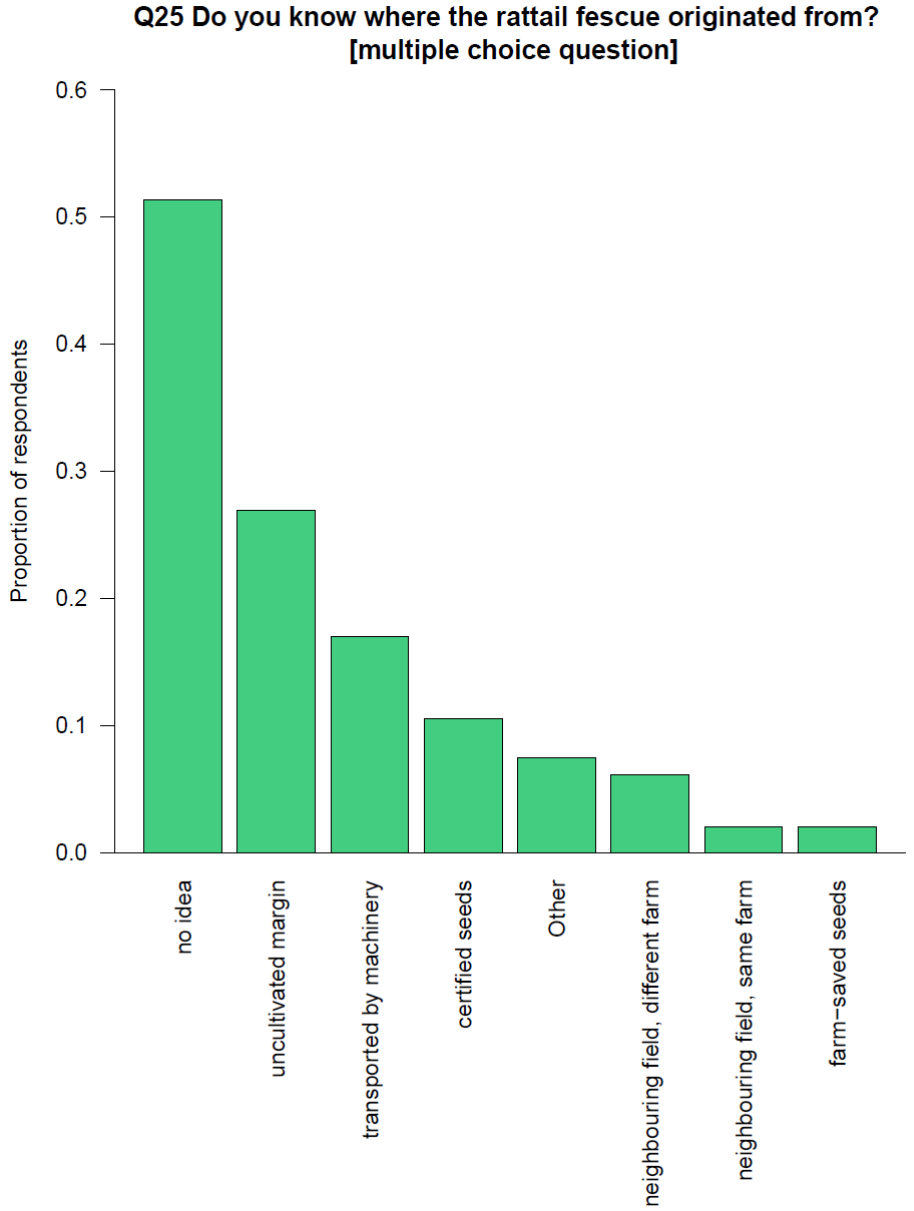
	total respondents	with Vulpia
France	314	254
UK	61	44
Switzerland	58	11
Germany	29	7
Belgium	12	5
total	474	321 (68%)

Survey

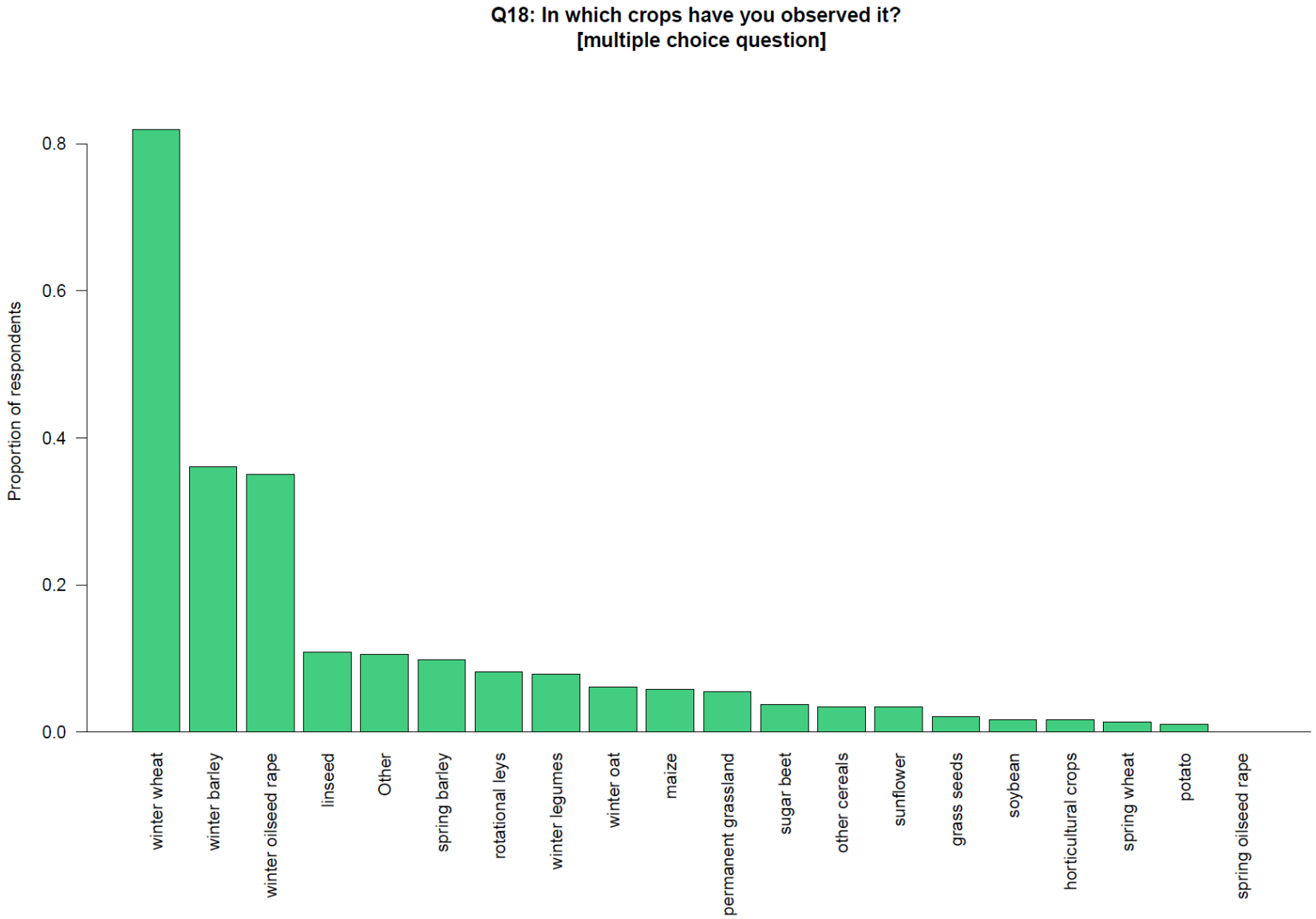

Q5: What describes best your farming practices?
[multiple choice question]
Proportion of respondents
0.0
0.2
0.4
0.6
0.8
no vulpia
vulpia
conventional
conservation
extensive
organic

Survey

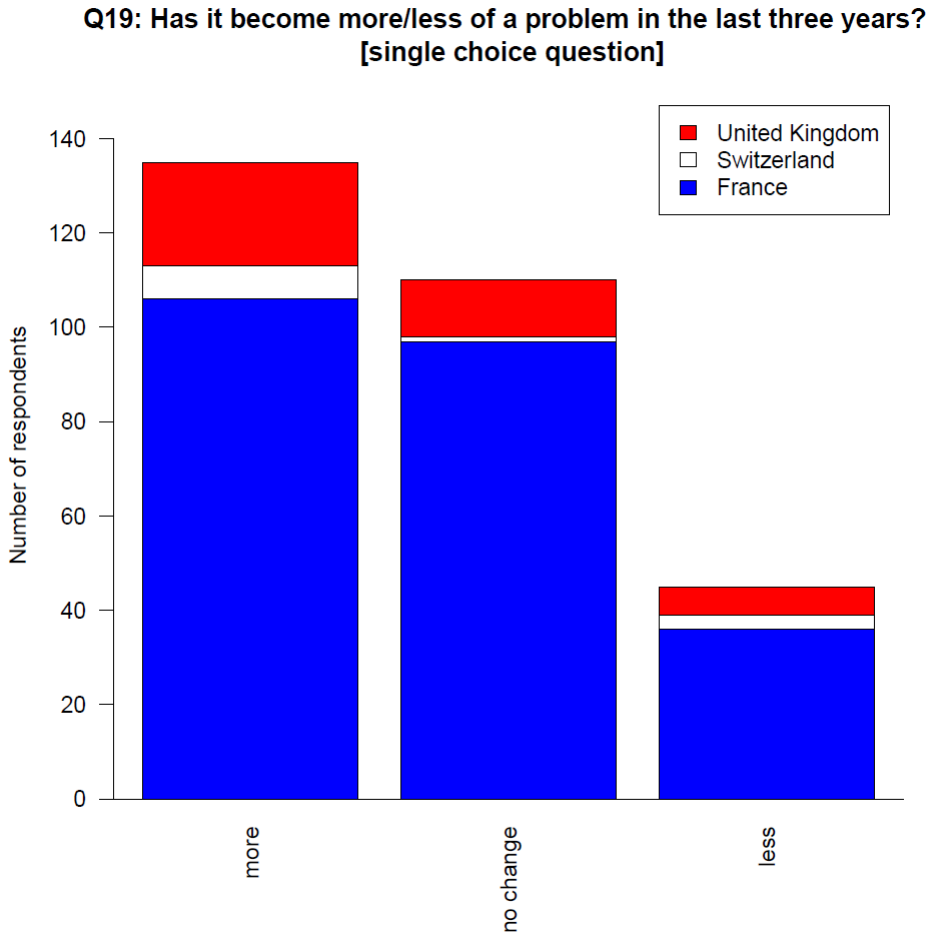

Q17: For how many years has rattail fescue been present on your farm?
[single choice question]
United Kingdom
Switzerland
France
Number of respondents
0
20
40
60
80
100
120
140
this year
1–2 years
3–5 years
6–10 years
11–20 years
more than 20 years

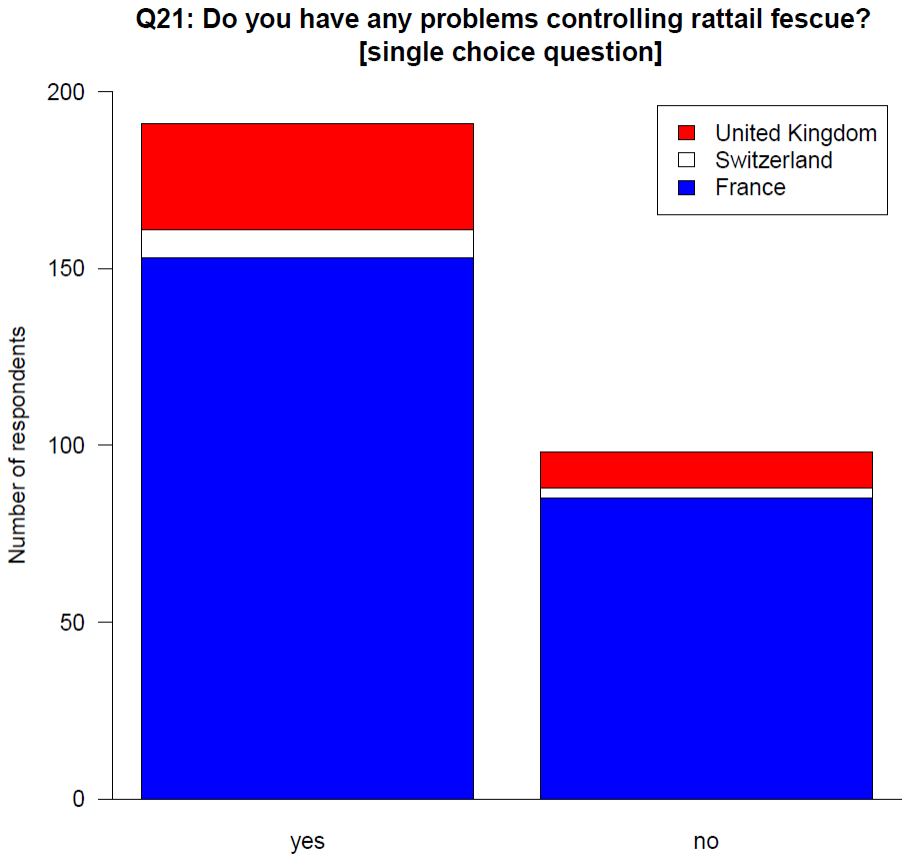

Q25 Do you know where the rattail fescue originated from?
[multiple choice question]
Proportion of respondents
0.0
0.1
0.2
0.3
0.4
0.5
0.6
no idea
uncultivated margin
transported by machinery
certified seeds
Other
neighbouring field, different farm
neighbouring field, same farm
farm−saved seeds

Survey

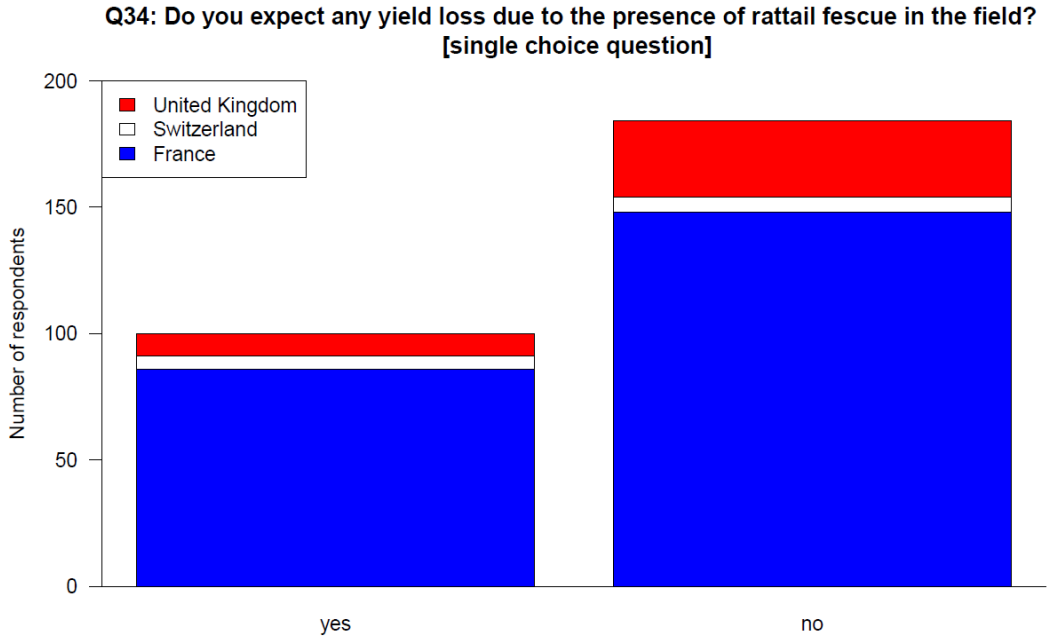

Q18: In which crops have you observed it?
[multiple choice question]
Proportion of respondents
0.0
0.2
0.4
0.6
0.8
winter wheat
winter barley
winter oilseed rape
linseed
Other
spring barley
rotational leys
winter legumes
winter oat
maize
permanent grassland
sugar beet
other cereals
sunflower
grass seeds
soybean
horticultural crops
spring wheat
potato
spring oilseed rape

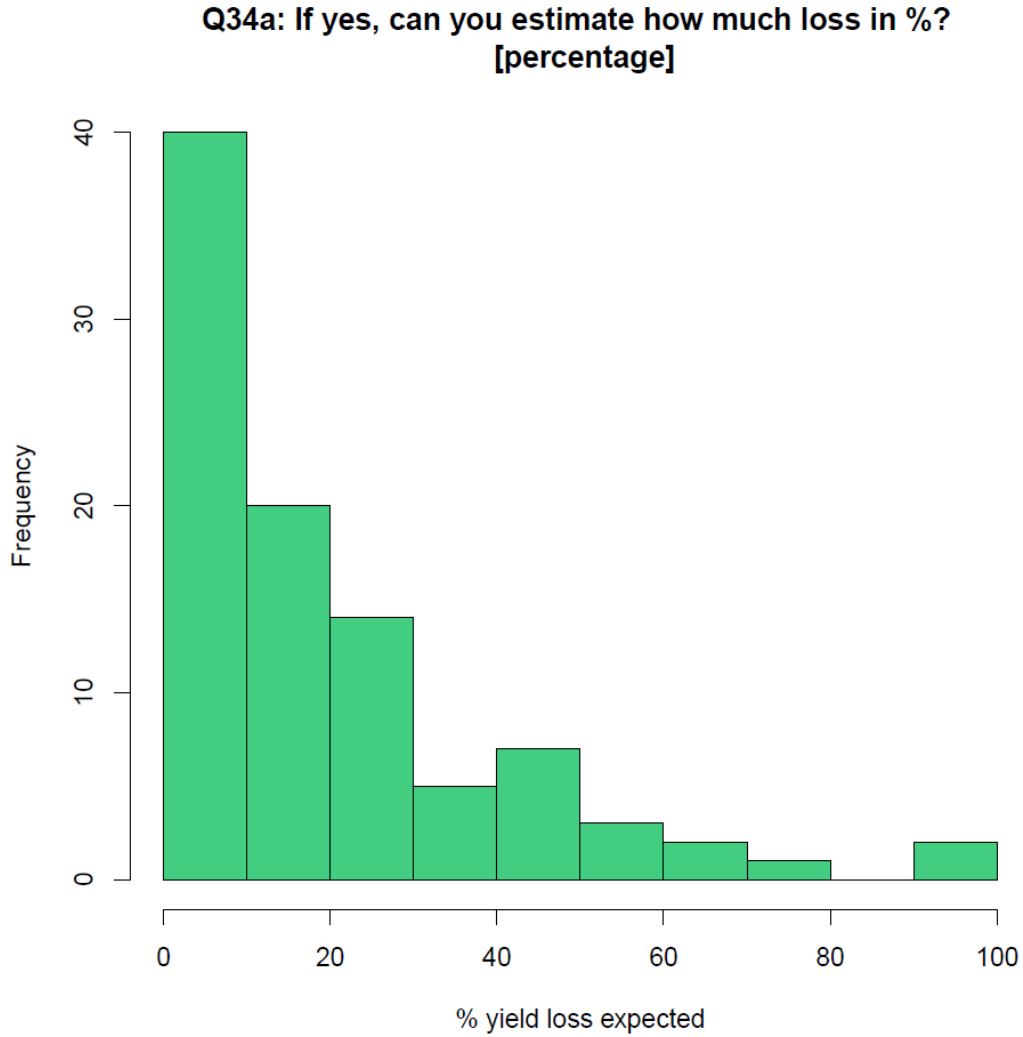
Survey


Q19: Has it become more/less of a problem in the last three years?
[single choice question]
United Kingdom
Switzerland
France
Number of respondents
0
20
40
60
80
100
120
140
more
no change
less


Q21: Do you have any problems controlling rattail fescue?
[single choice question]
United Kingdom
Switzerland
France
Number of respondents
0
50
100
150
200
yes
no

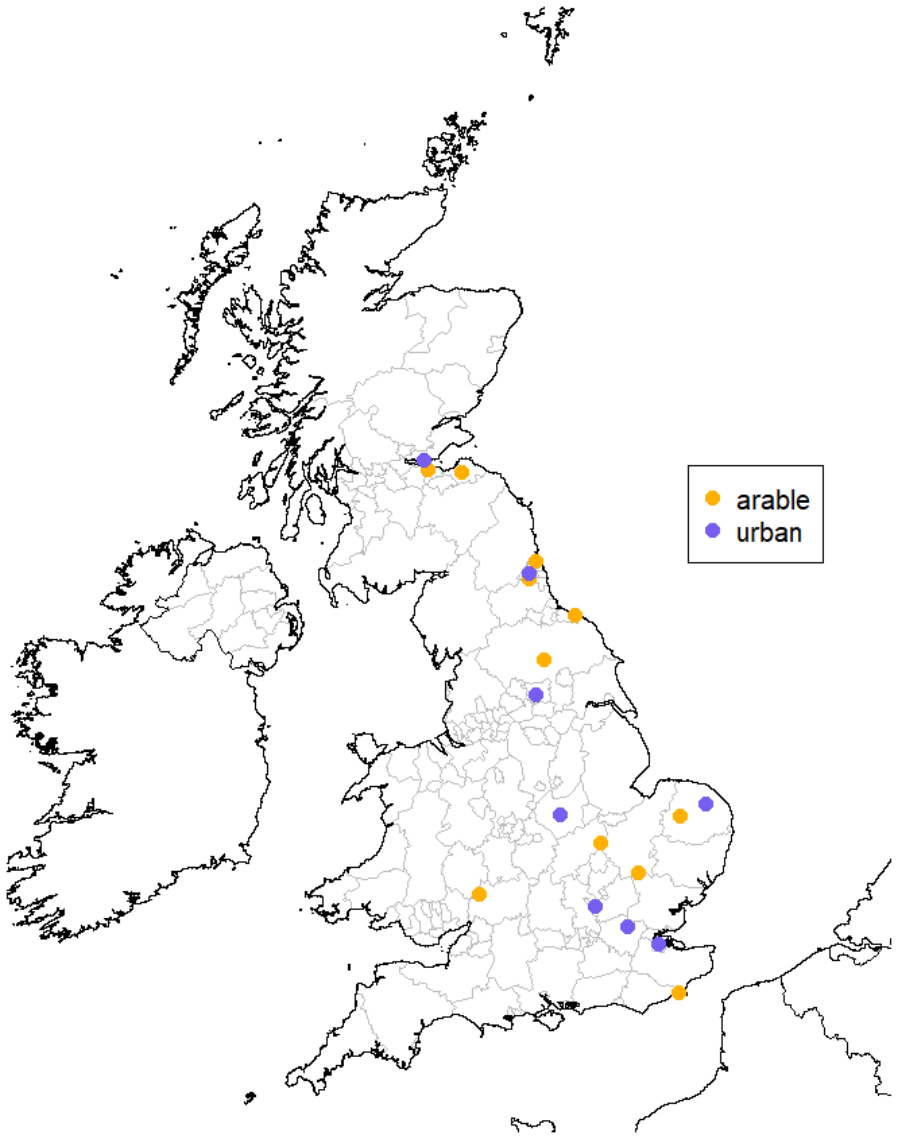
Survey


Q34: Do you expect any yield loss due to the presence of rattail fescue in the field?
[single choice question]
United Kingdom
Switzerland
France
Number of respondents
200
150
100
50
0
yes
no

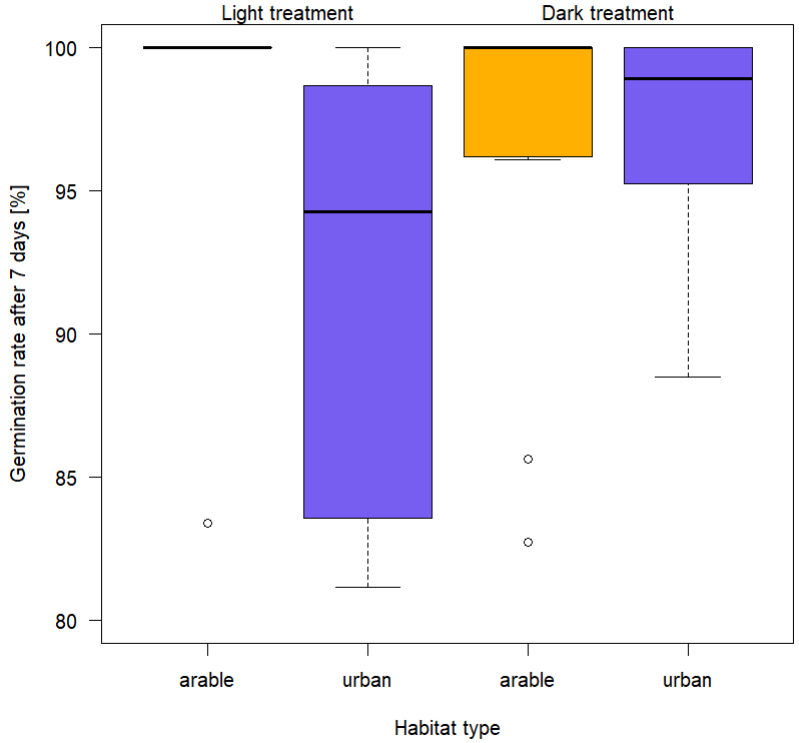

Q34a: If yes, can you estimate how much loss in %?
[percentage]
Frequency
40
30
20
10
0
0
20
40
60
80
100
% yield loss expected

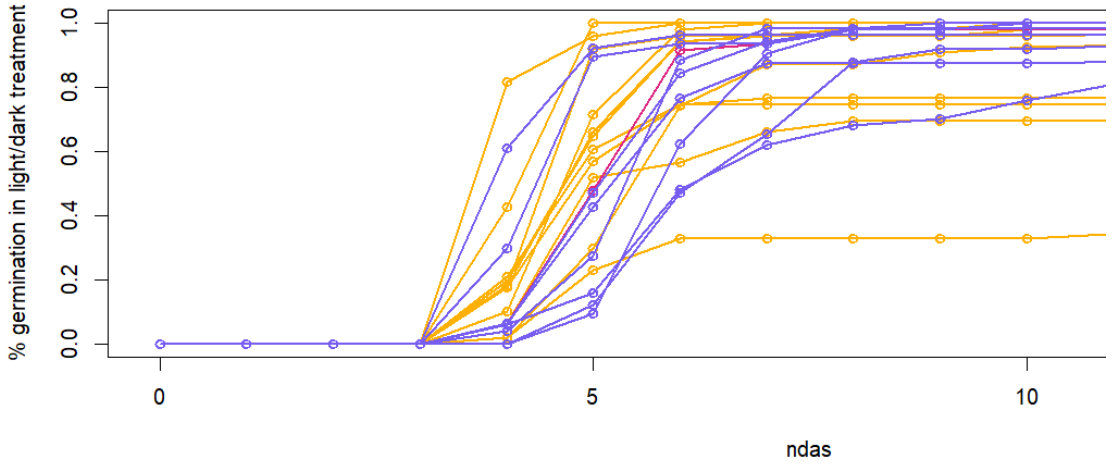
Phenotyping

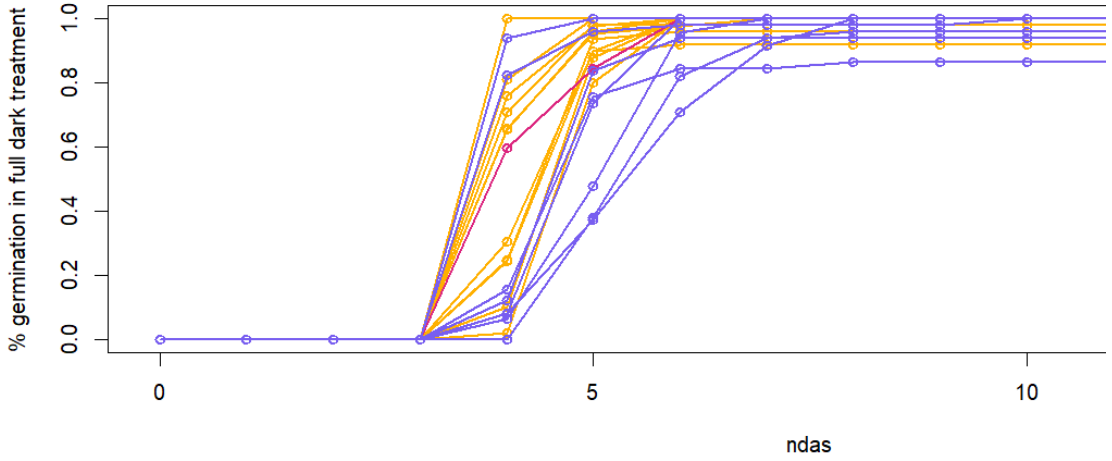
- 11 arable vs 8 urban populations
- set of experiments to compare those populations, done at NIAB (Daniella Bryce and John Cussans) and NRI



Germination experiments

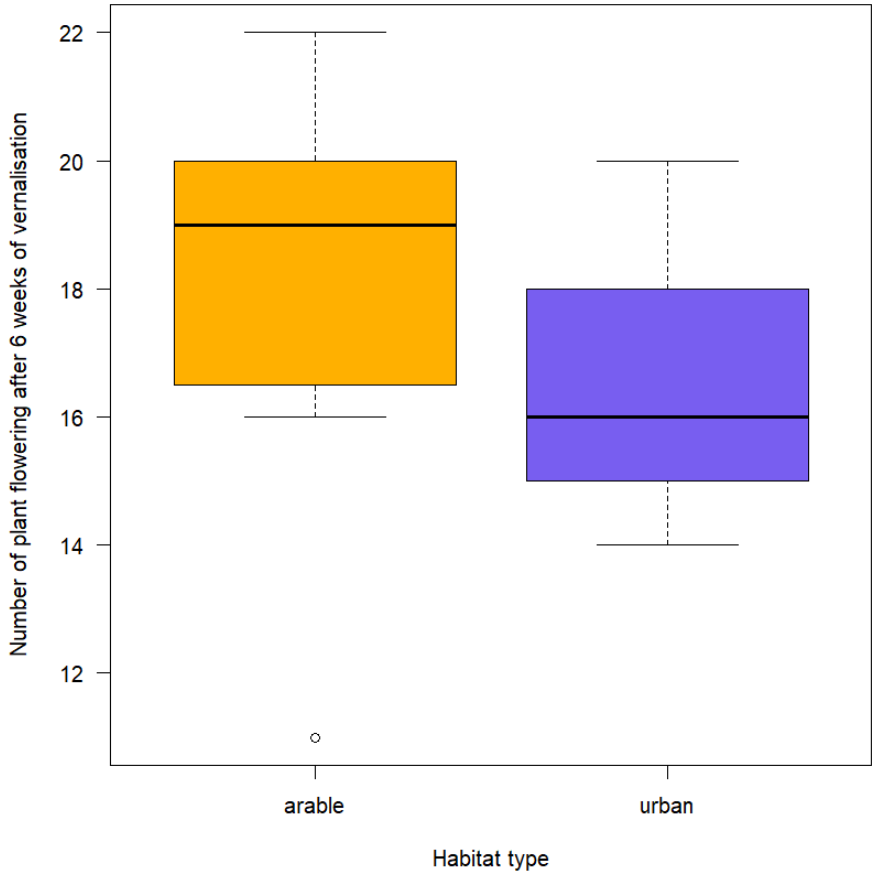






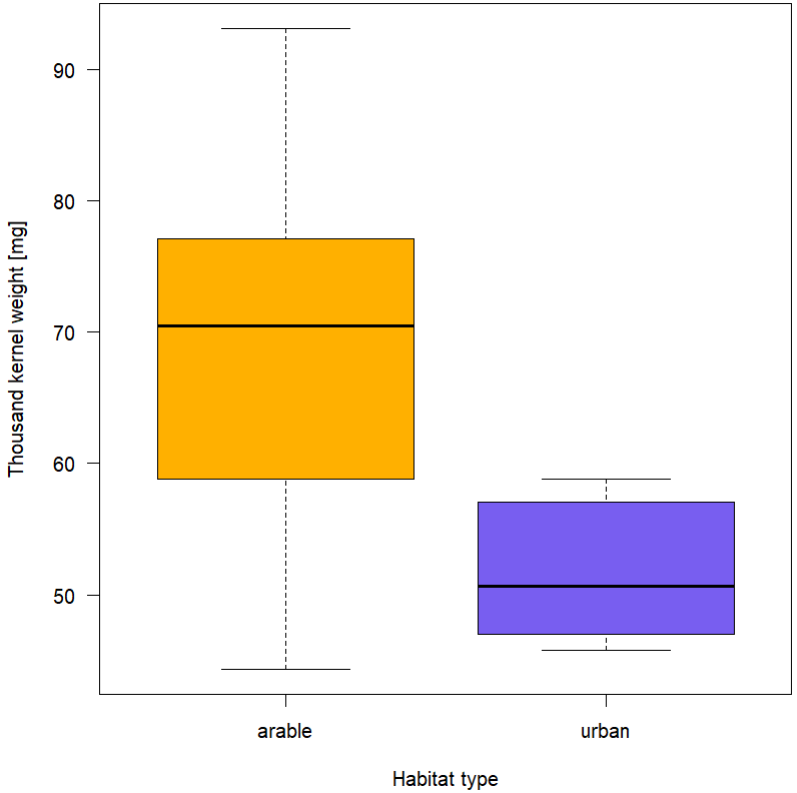
Vernalisation experiment

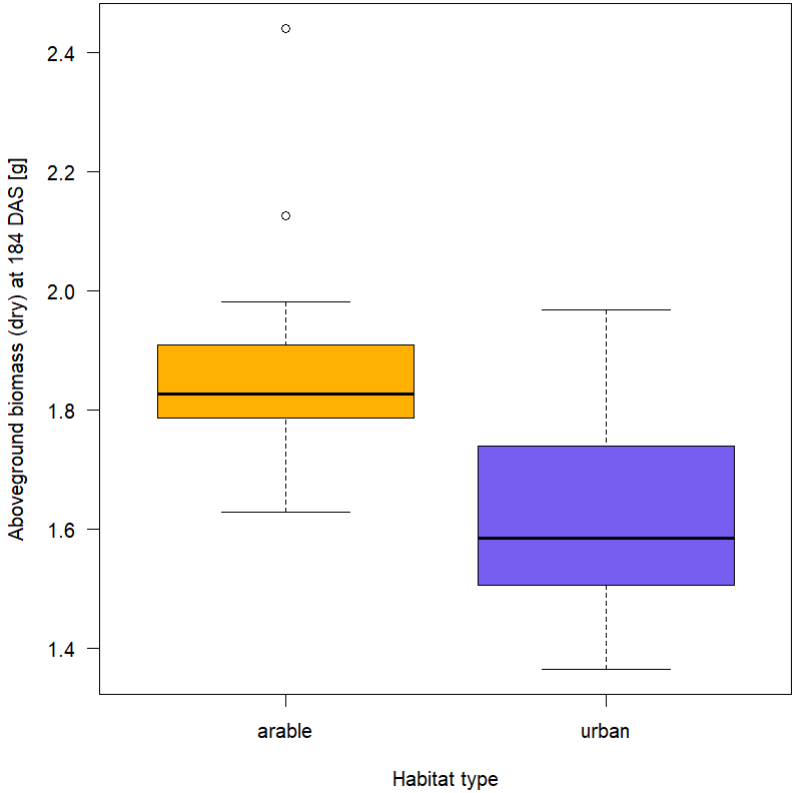
- vernalisation at 4-5°C
- 6 weeks, no significant difference, p=0.188
- for 3 weeks vernalisation, only 1 plant flowered for the whole dataset
- no flower without vernalisation!
- but...



Pot experiment

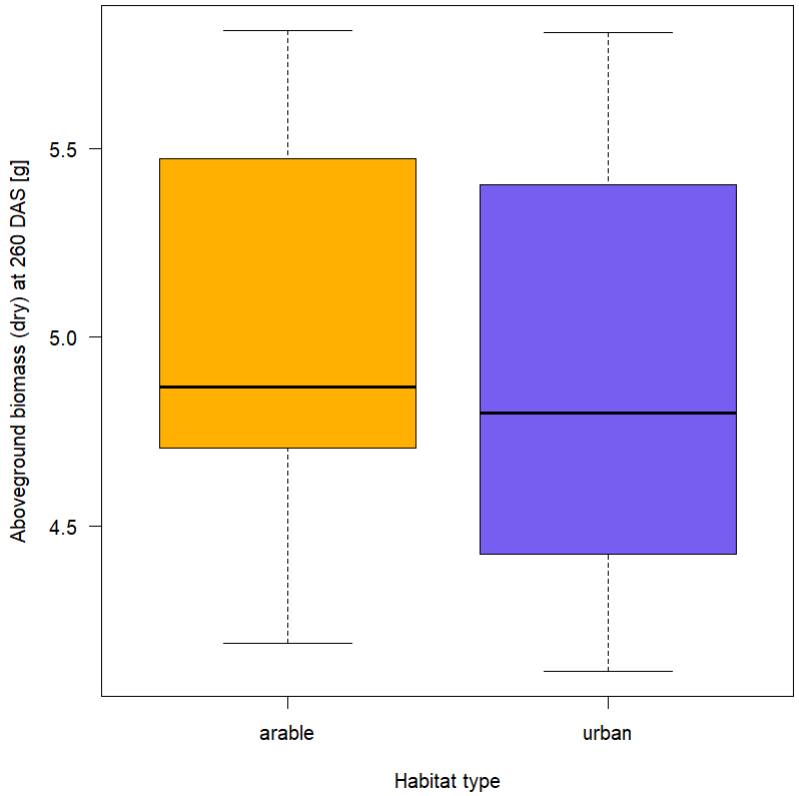
- 10 individuals per population grown in 1L pot
- sowing October 2023 - vegetative biomass: April 2024 - final harvest July 2024

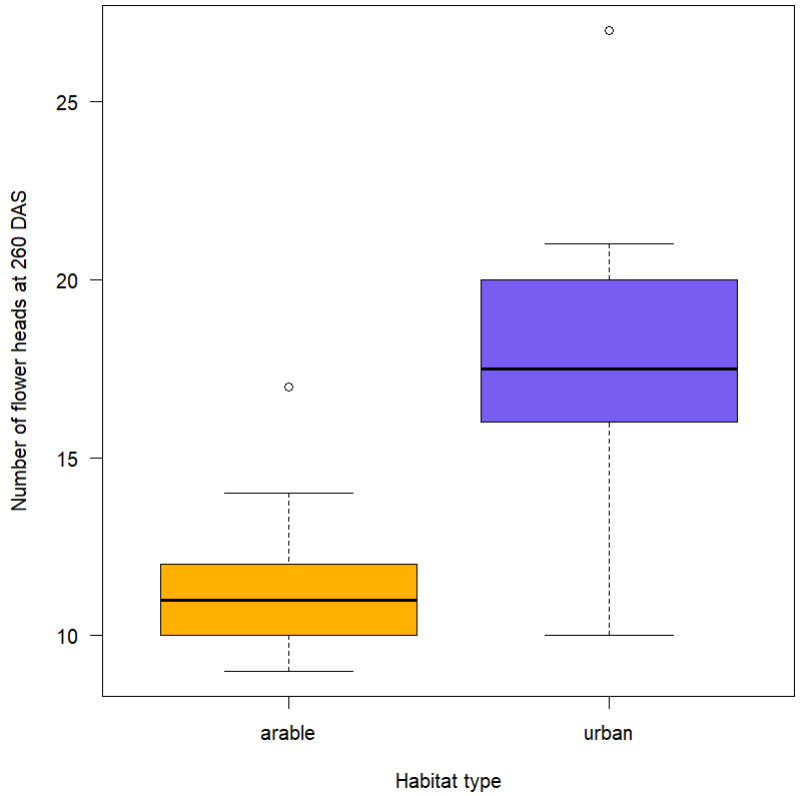




- urban pop with smaller seeds
- lower vegetative biomass and height for urban vs arable pops

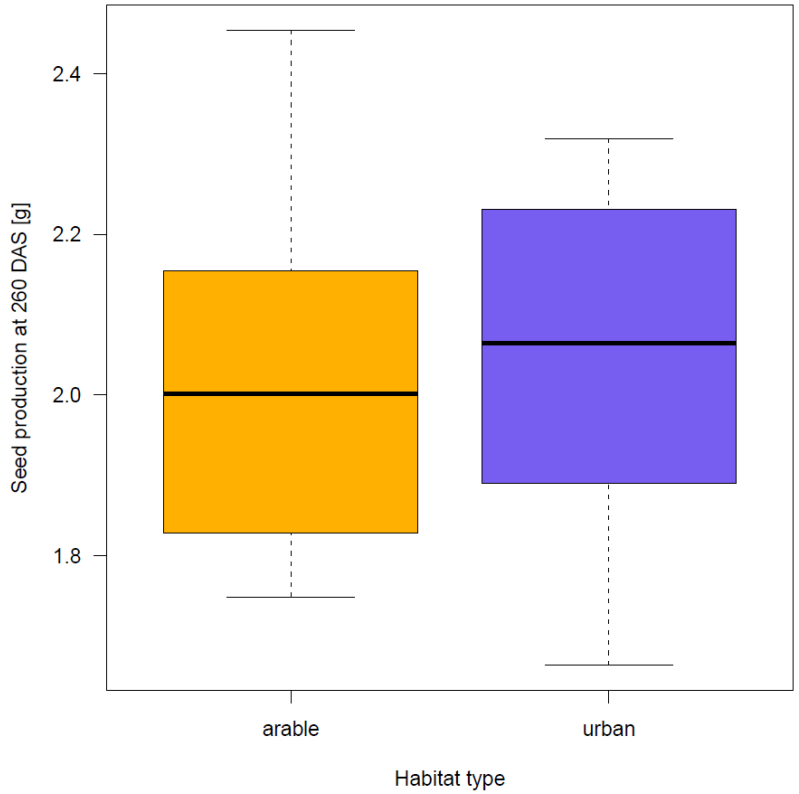
Pot experiment

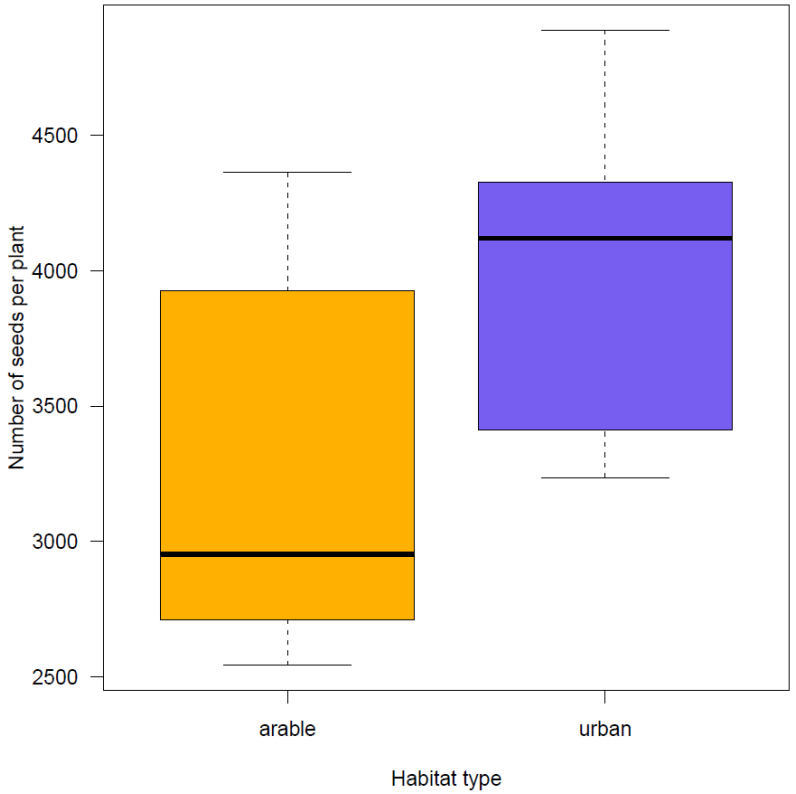




- but no difference in biomass at maturity
- urban pop showed a higher number of flower heads

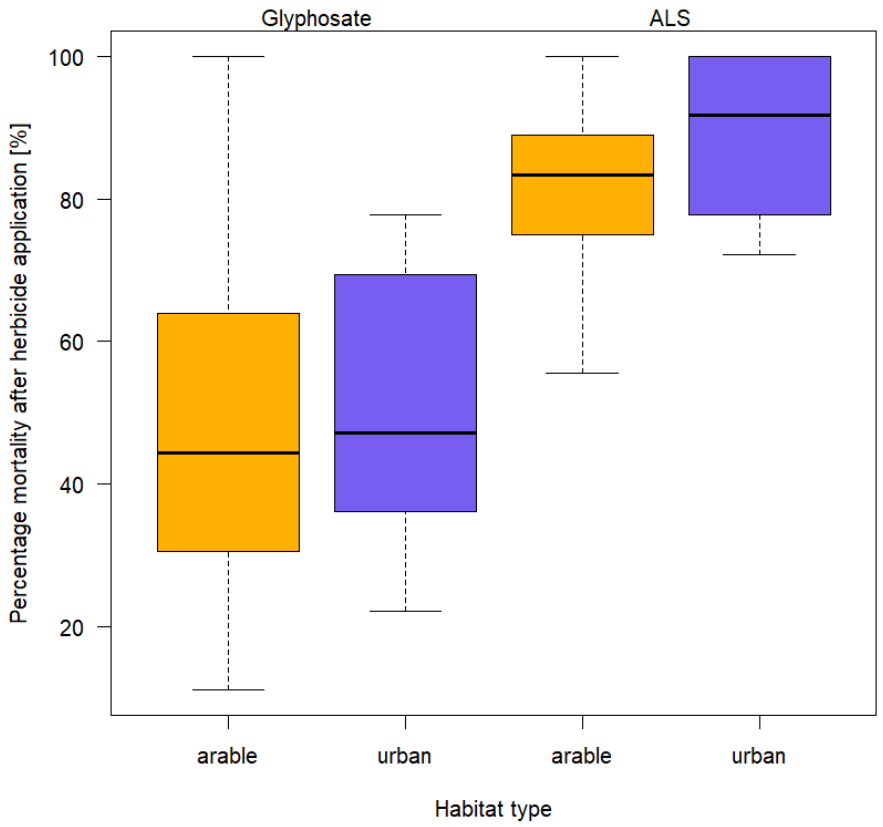
Pot experiment

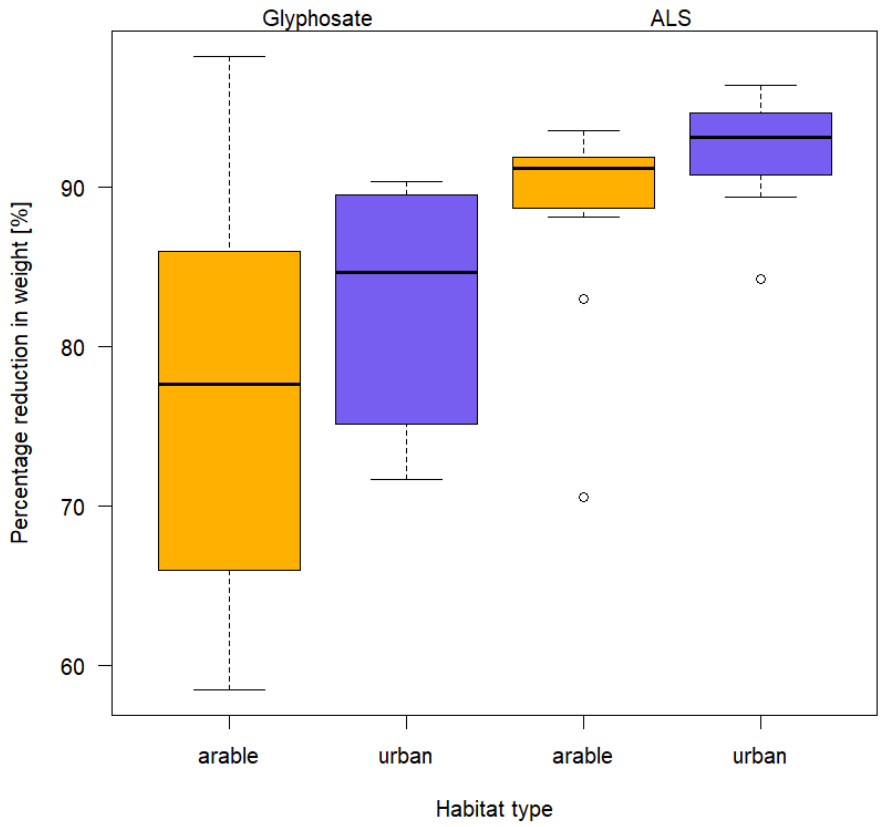




- but no difference in total seed production (biomass)
- however, smaller TKW => higher number of seeds for urban populations

Herbicide experiment





- no significant differences
- but slight trend towards higher impact of herbicide on urban populations

- GAT (arable) has 100% sensitivity to glyphos (and is also an outlier in terms of seed weight, very low)

Current and future projects

- Kainat's phd project
- Can *V. myuros* be a reservoir for BYDV? Exploratory project with colleagues working on BYDV, aim to sample some winter wheat fields with *V. myuros* in spring
- Other 'emerging weeds' project: parasitic weeds in northwest Europe, a survey will be launched soon, help us distribute it!

PhD in Agriculture, Health and Environment

PhD Project: Elucidating the ecological and agricultural niche of the grass weed *Vulpia myuros*

Kainat Bibi

Supervised by: Lucie Büchi, Truly Santika and Jonne Rodenburg

Natural Resources Institute / University of Greenwich


photo: @Kainat Bibi

Objectives

1. Ecological niche

- Mapping of species occurrence data
- Modelling

2. Agricultural niche

- Competition experiments
- Farm survey analysis

3. Future expansion

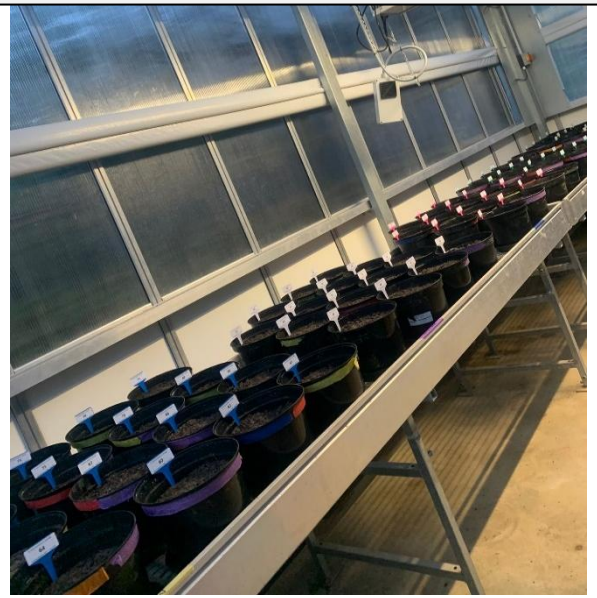
- Habitat distribution modelling

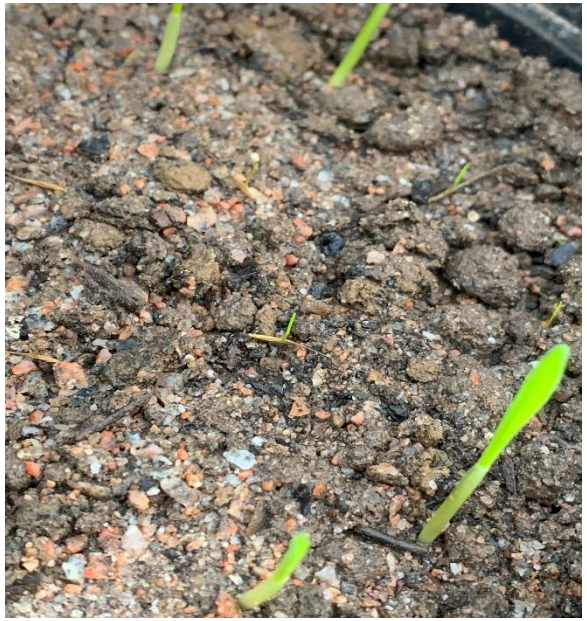
Agricultural niche: Current projects

Pot experiment

Rationale:

- To compare the weediness of *Vulpia myuros* to *Vulpia bromoides* with and without winter wheat
- Impact on weed growth in the presence of winter wheat
- Assessment of varying nitrogen fertiliser levels (0, 25%, 50%, 100%, 200%)
- **Measurable Traits:** Growth parameters include germination rate, plant height, biomass, and reproductive traits (e.g., days to flowering, seed count per head).



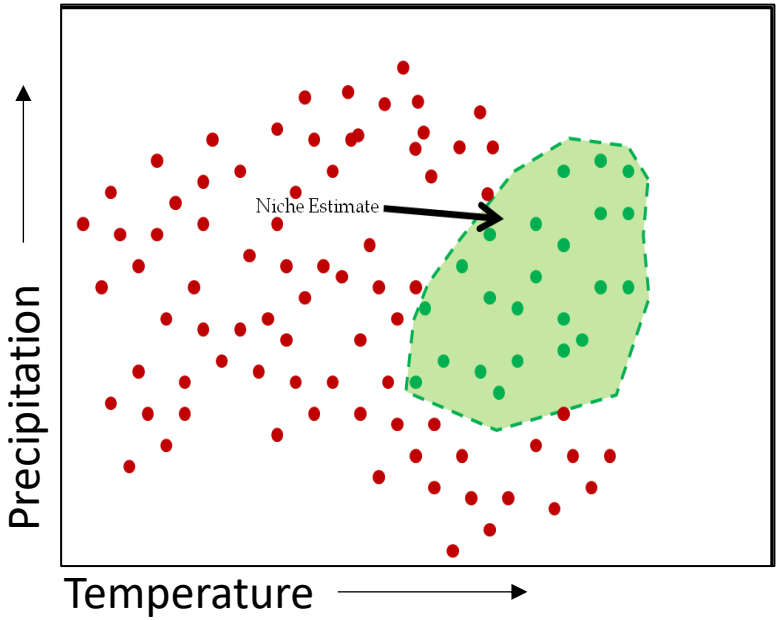


Experiment 2: Raised-bed experiment

- Assessment of yield loss in winter wheat and faba bean by different *Vulpia myuros* densities
- ***Vulpia myuros* densities**
  - 100 plants/m2
  - 500 plants/m2
  - 1000 plants/m2
- **Data collection**
  - Morphological and competition traits between crops and *Vulpia myuros*.
- **Crops and weed**
  - Wheat
  - *Faba bean*
  - *Vulpia myuros*

Ecological niche modelling

- Numerical tools that combine observations of species occurrence or abundance with environmental factors (temperature, precipitation etc.)
- Used to gain ecological and evolutionary insights
- To predict distributions across landscapes



Data collection: Past, present and future climate and species occurrence

Modelling with ecological niche models for different climates

Modelling predictions: Past, current and future expansion of *V. myuros*

Validation: potential distribution

Contribution of environmental factors toward distribution of ten most dangerous weed species globally by Wan, J. Z and Wang, C. J (2019)

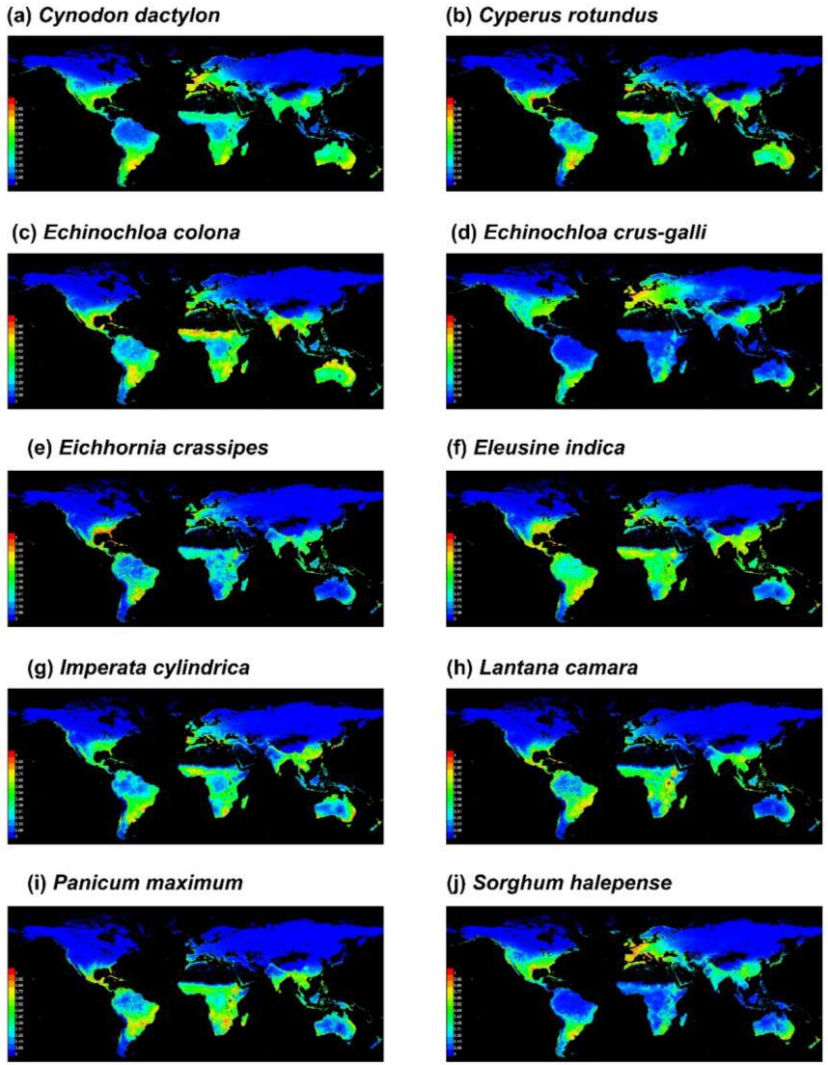


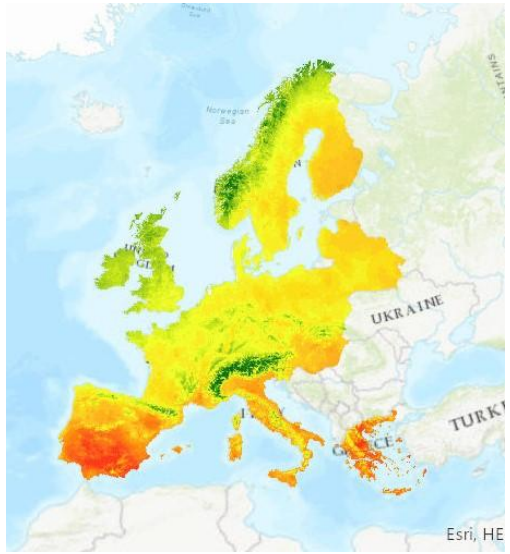
Fig. The distribution of 10 most dangerous weed species on a global scale.

- Used a similar approach.

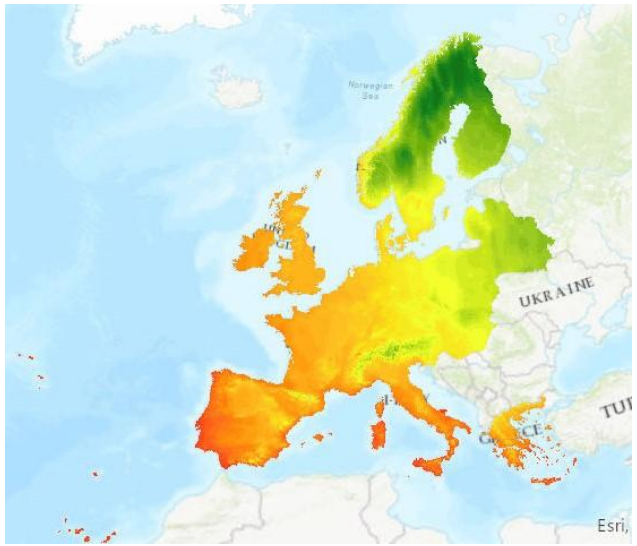
Species distribution modelling for V. myuros and V. bromoides

- **Rationale:**
- To predict the future expansion of *V. myuros* in changing climatic conditions
- **Method:**
- Raster analysis of climatic data for Europe and the UK (1980-2024)

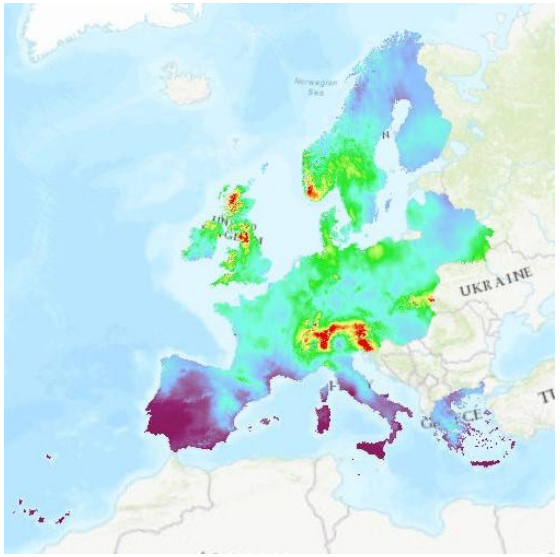
- **Factors:**
- Maximum, minimum temperature, precipitation, population density, arable and non-arable fields data
- Points for presence-absence data
- Mapping of presence data of *V. myuros* from (1980-2024)



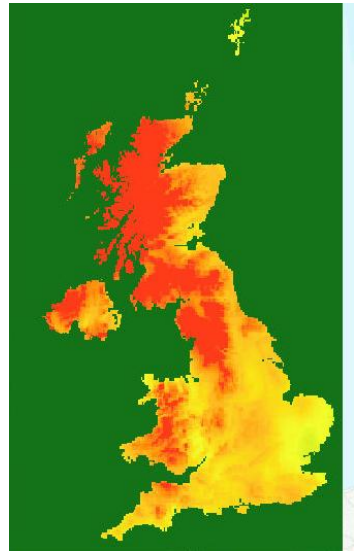
Maximum temperature recorded in June 1980



Minimum temperature recorded in January 1980



Precipitation recorded in June 1980



Precipitation recorded in Summer 1980 in the UK

Questions?

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