Elucidating the ecological and agricultural niche of the grass weeds *Vulpia myuros* and *Vulpia bromoides*

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Field photograph: Lucie Büchi



V. myuros



V. bromoides

UNIVERSITY OF GREENWICH

Natural Resources Institute

Two annual grass species in my PhD research

Vulpia myuros

Rat's-tail fescue

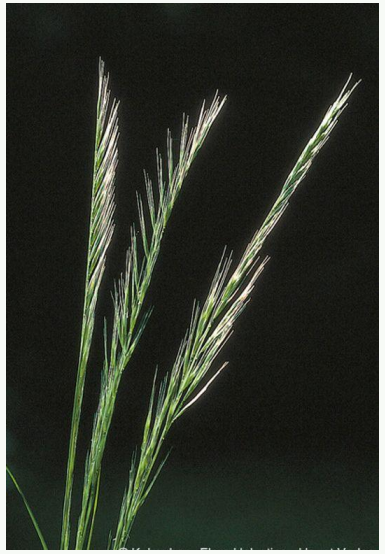


Photo: Flora Helvetica

- Annual grass
- Established as an agricultural weed in parts of Europe (Büchi et al., 2021).
- Produces a large number of seeds

Vulpia bromoides

Squirrel's tail fescue



Photo: Go Botany, USA

- Annual grass
- Related species
- Successful weed in countries like Australia and New Zealand (Dillon and Forcella, 1984; Dowsett et al., 2018)

Shared genus, contrasting agricultural contexts - studied within one PhD project

Agricultural context and rationale

V. myuros

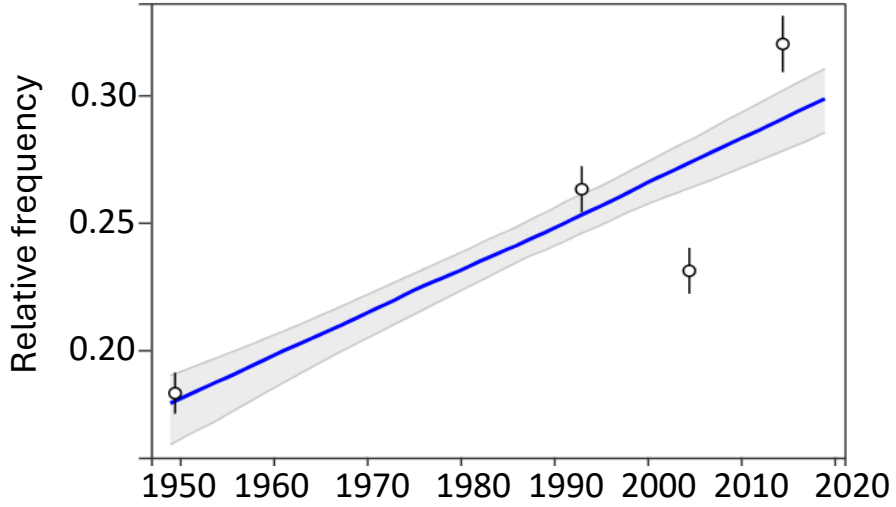
An emerging arable weed in Western Europe; particularly in reduced-tillage systems (Melander et al., 2013).

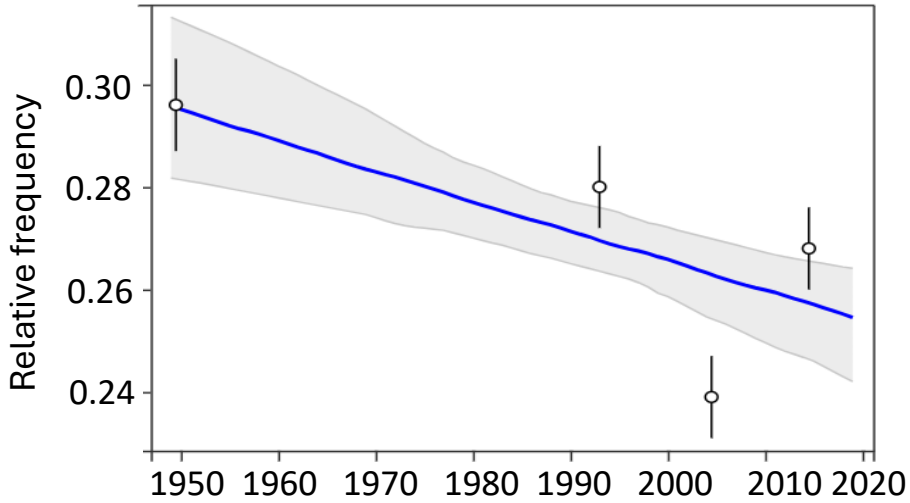
V. bromoides

Not considered a weed, but largely found in the country as a grass.
A related annual grass that provides a useful comparison of biology and ecology.

Data source: BSBI Plant Atlas 2020

Distribution trends for *Vulpia myuros* in the UK





Distribution trends for *Vulpia bromoides* in the UK

Knowledge gap: What explains the weediness of *Vulpia myuros*?

Understanding the ecological and agricultural niches of *Vulpia* species

01 ECOLOGICAL NICHE

Distribution modelling

How do environmental conditions shape the distribution and ecological niche of the species?

02 BIOLOGY AND ECOLOGY

Greenhouse experiments

How do biological traits and competitive interactions contribute to weed success?

03 AGRICULTURAL NICHE

Farmer survey

How do farming practices and management influence weed occurrence and success?

What shapes the ecological and agricultural niches of *Vulpia myuros* and *Vulpia bromoides*?

Species distribution modelling | Methodological overview

01 Occurrence data

1991-2024 occurrence records for *V. myuros* and *V. bromoides*

02 Environmental predictors

Climate: temperature, precipitation and vernalisation
Landscape: land use, elevation, roads, railways and water channels

03 Statistical modelling

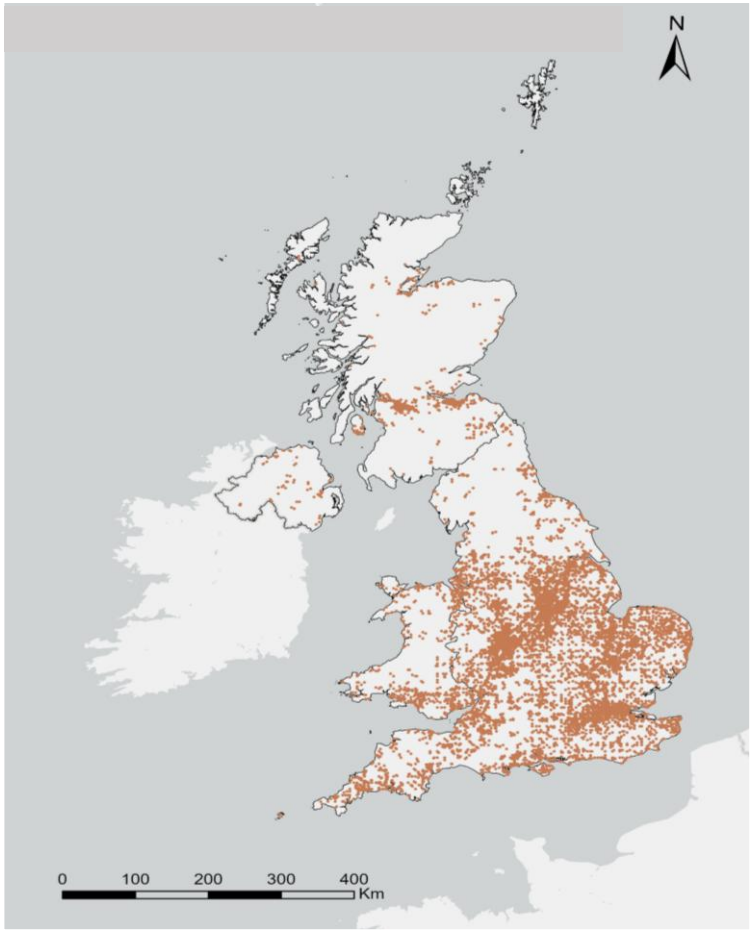
Two-stage Generalised Additive Models (GAMs)
Recording-effort model used as an offset in the ecological model

04 Spatial predictions

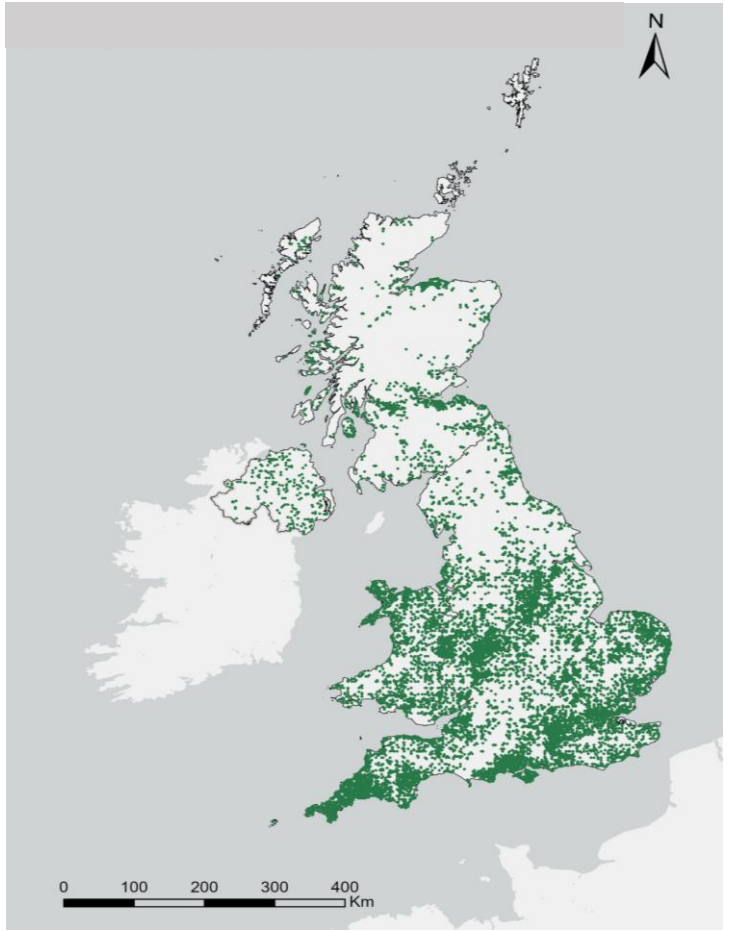
Modelled habitat suitability across the UK
Regional and temporal patterns of suitability

Distributions of *Vulpia myuros* and *Vulpia bromoides* across the UK

Species occurrence records (1991-2024) | NBN Atlas



Recorded occurrences of *V. myuros*



Recorded occurrences of *V. bromoides*

***V. myuros*: Concentrated in southern and eastern England**

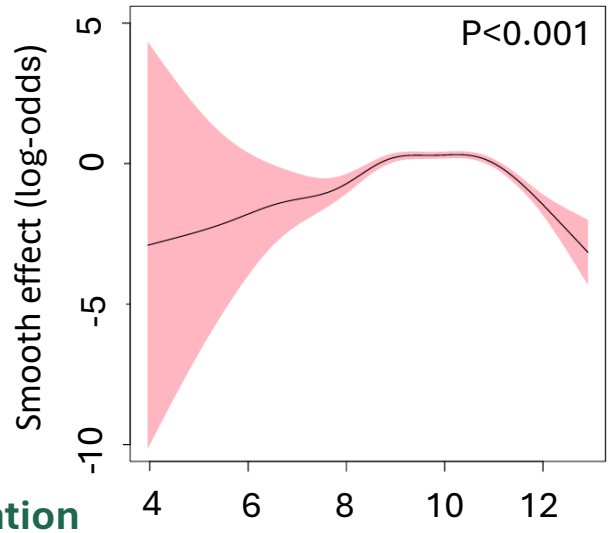
***V. bromoides*: More widely recorded, extending into Wales, western Britain and parts of Scotland**

black line = fitted effect; pink shading = 95% confidence interval

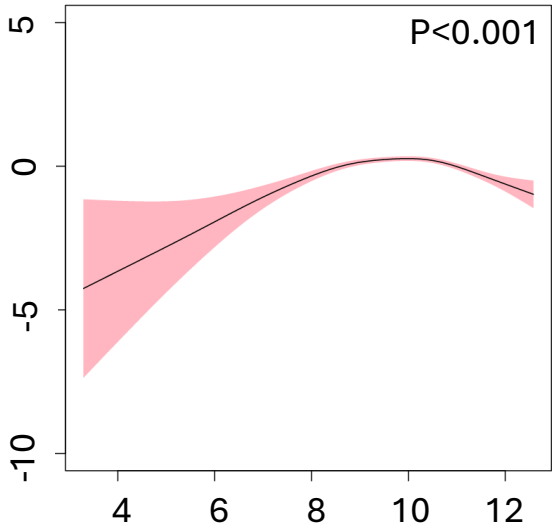
Climatic GAM partial effects

Mean annual temperature

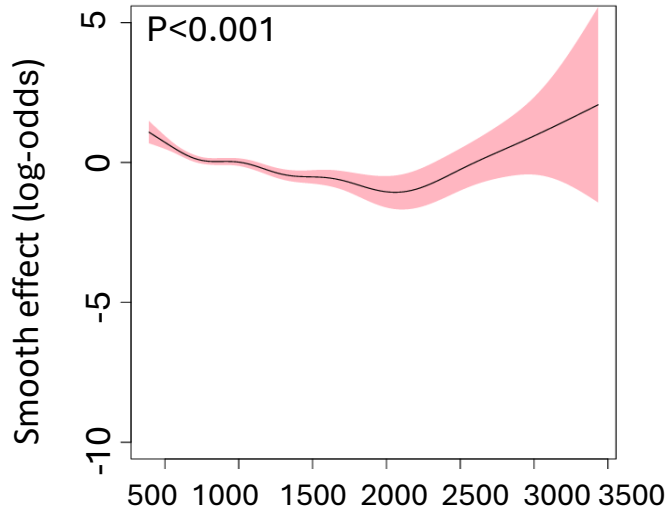
Vulpia myuros

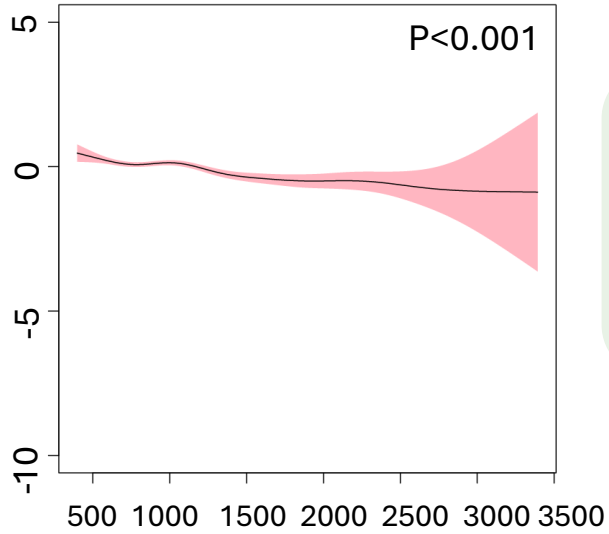


Vulpia bromoides



Total annual precipitation





Temperature: Preliminary GAM results suggest broadly similar temperature responses in both species.

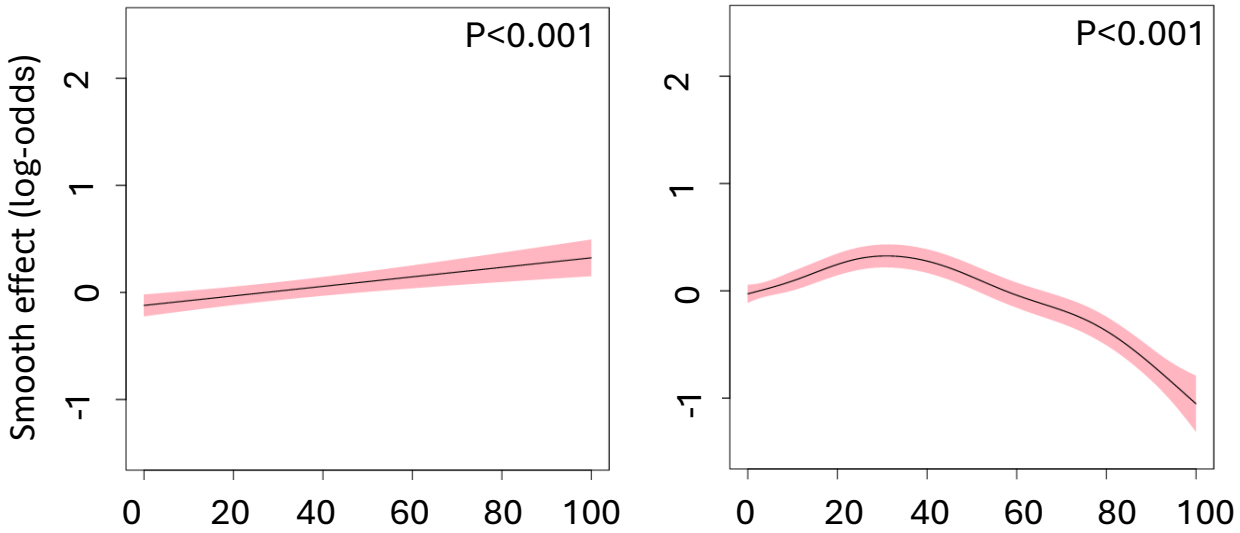
Precipitation: Apparent increase in *V. myuros* may be a modelling artefact.

black line = fitted effect; pink shading = 95% confidence interval

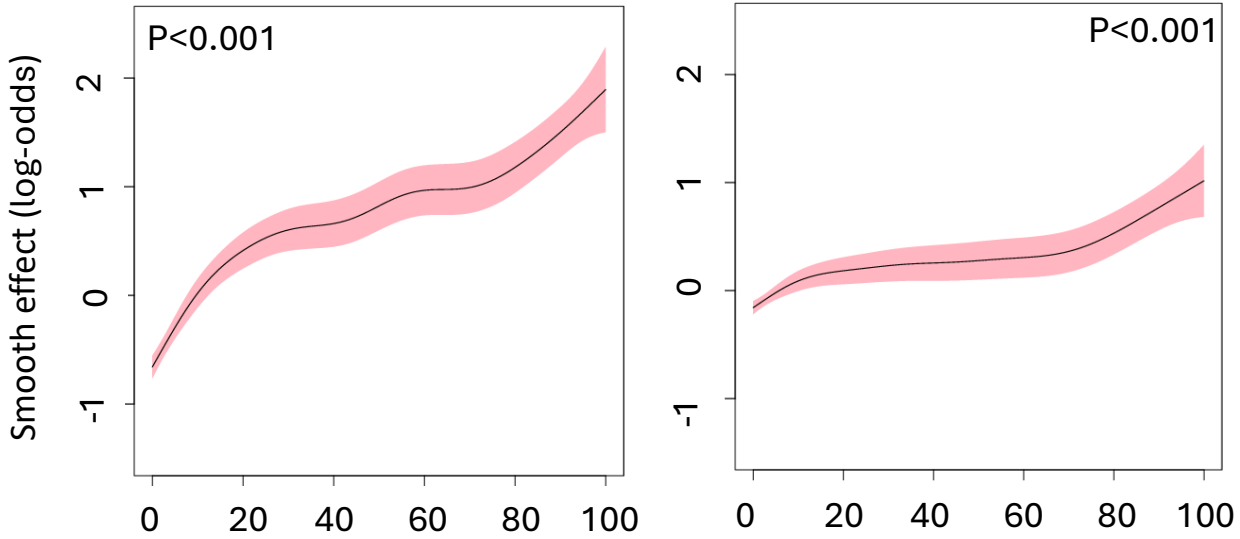
Landscape GAM partial effects

Vulpia myuros | ***Vulpia bromoides***

Arable land (%)



Urban land (%)

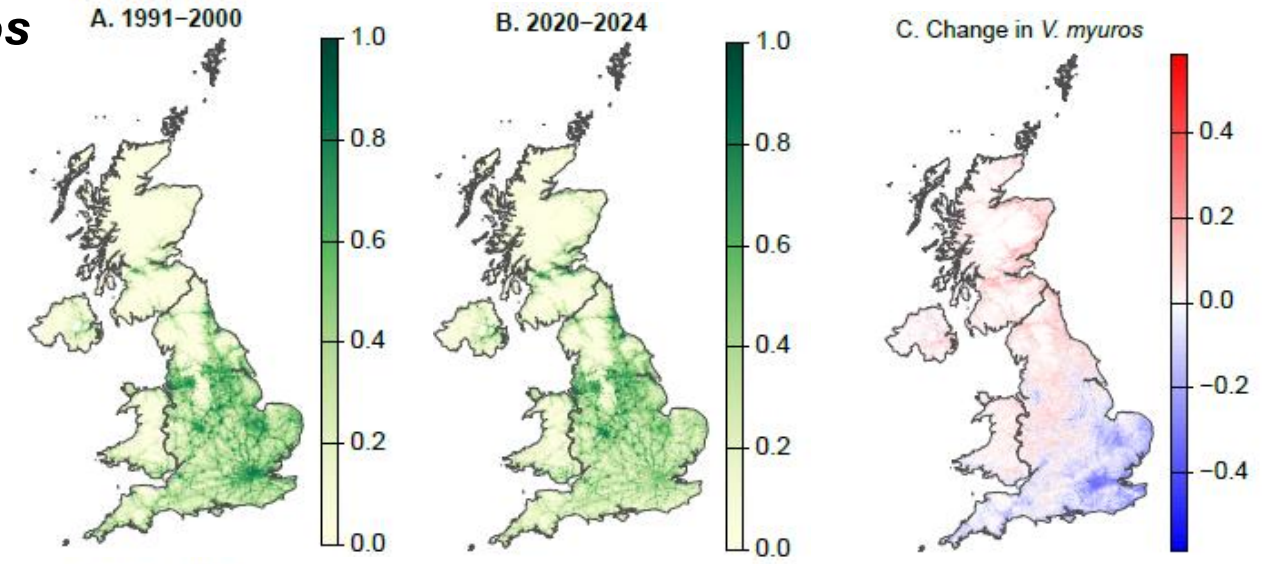


Arable land (%): *V. myuros* favoured arable landscapes

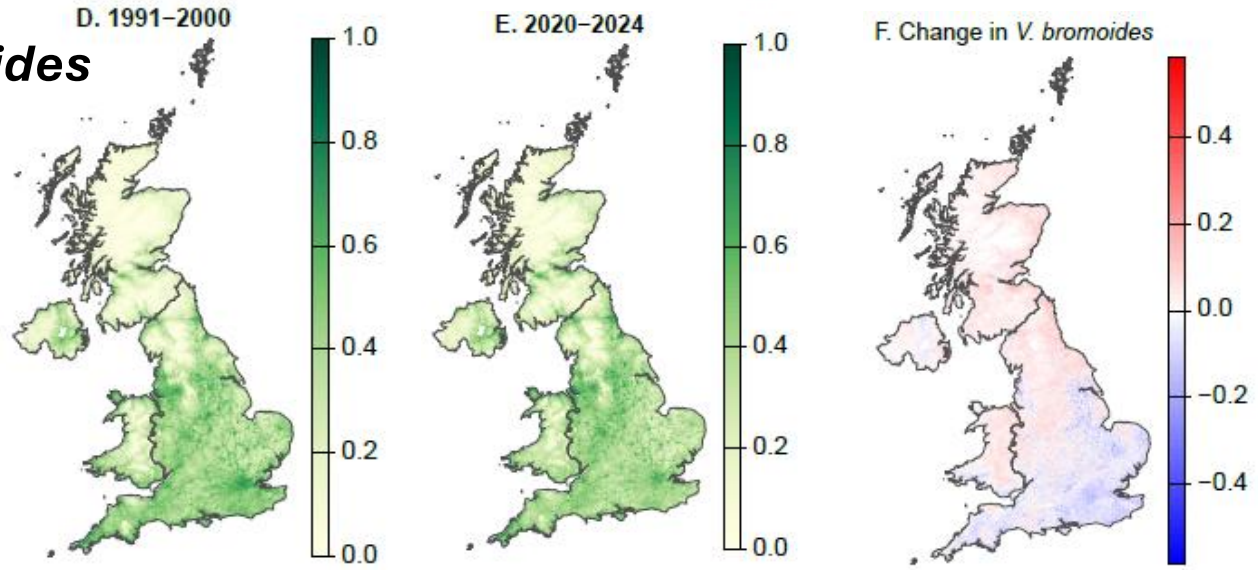
Urban land (%): Both species favoured more urbanised landscapes.

Preliminary modelled habitat suitability (1991-2024)

Vulpia myuros



Vulpia bromoides



Key findings

Southern and eastern England

Declining modelled suitability for both species, particularly *V. myuros*.

Scotland and northern Britain

Increasing modelled suitability for both species in several areas.

Green: modelled suitability (0-1). Blue-white-red: difference in modelled suitability (last period - first period).

Greenhouse experiments: biology and ecology of *Vulpia* species

Research aim

How do *V. myuros* and *V. bromoides* differ in growth, reproduction and their effects on crops?

V. myuros	***V. bromoides***
	

Photos: Kainat Bibi

EXPERIMENTAL OVERVIEW

- Germination and phenotyping
- Vegetative and reproductive growth
- Nitrogen fertiliser responses
- Competition with crops
- Management responses

Growth experiment | Experimental design

Two species
V. myuros and *V. bromoides*

Setting
Greenhouse; semi-controlled conditions

Nitrogen treatments
Recommended dose for winter wheat (0 and 100%)

Destructive harvest timeline (18 harvests)

01 Harvest groups 1-12
Every 2 weeks
3 pots per species per harvest

→

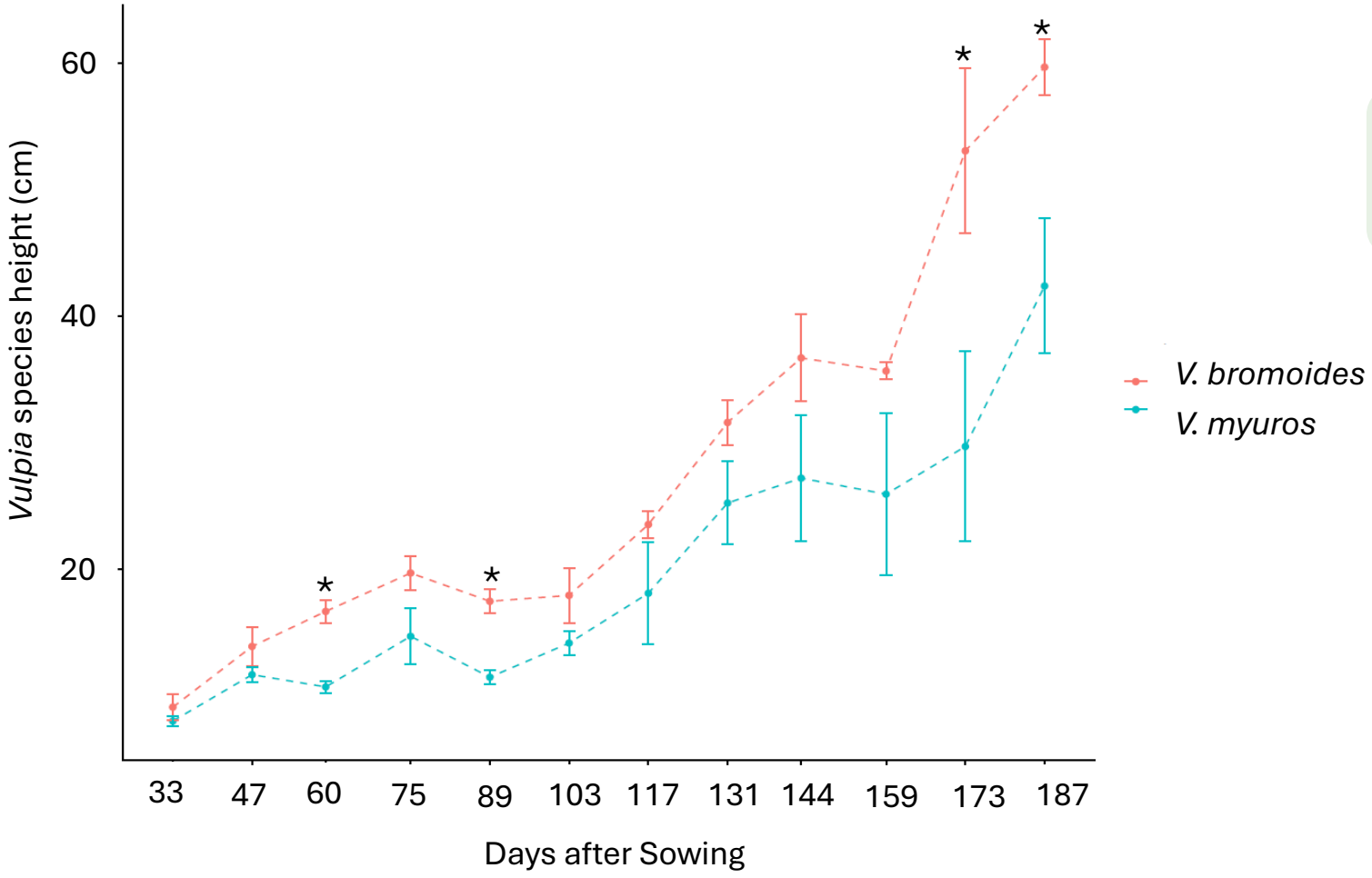
02 Nitrogen treatment
Applied before Group 13
Rates: 196, 206, 215, 231 DAS

→

03 Harvest groups 13-18
6 pots per species × N treatment per harvest

Measurements
Plant height • Aboveground dry biomass • number of leaves • number of tillers

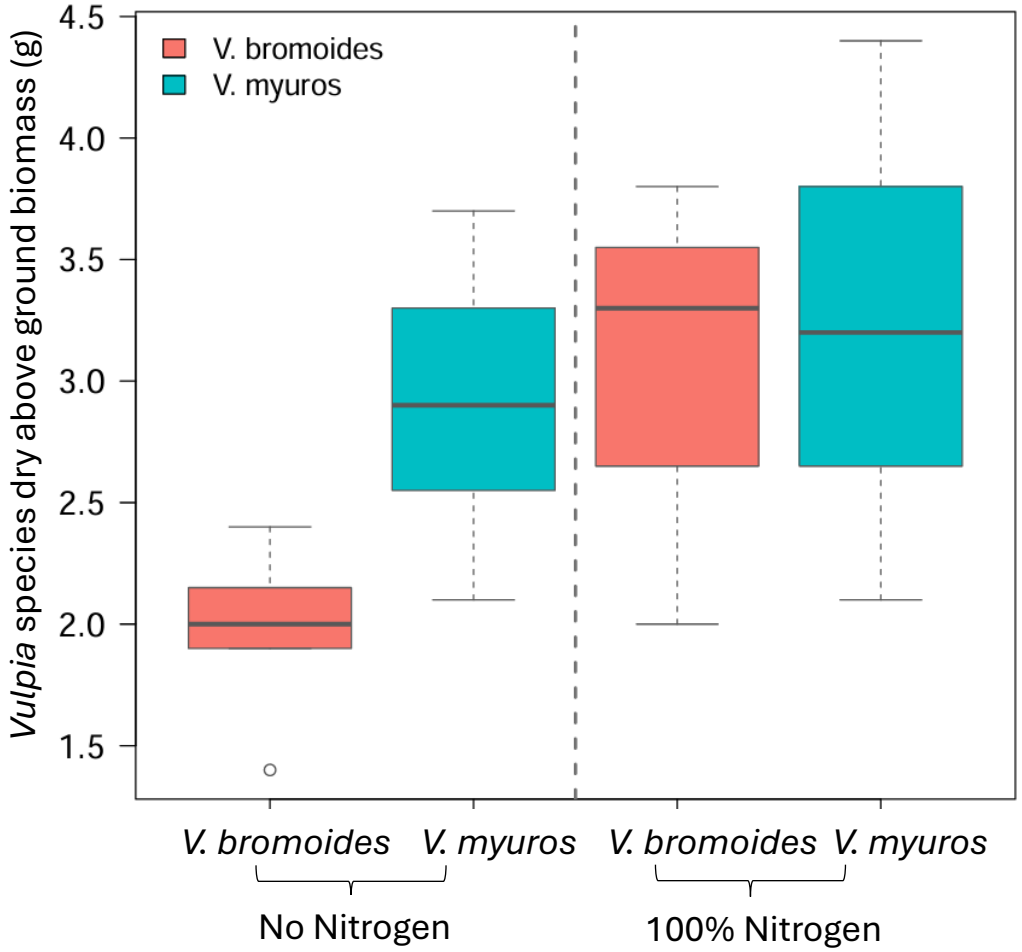
Vulpia species height during the vegetative growth



***V. bromoides* was generally taller.**

* Significant differences

Above-ground dry biomass (g) at maturity



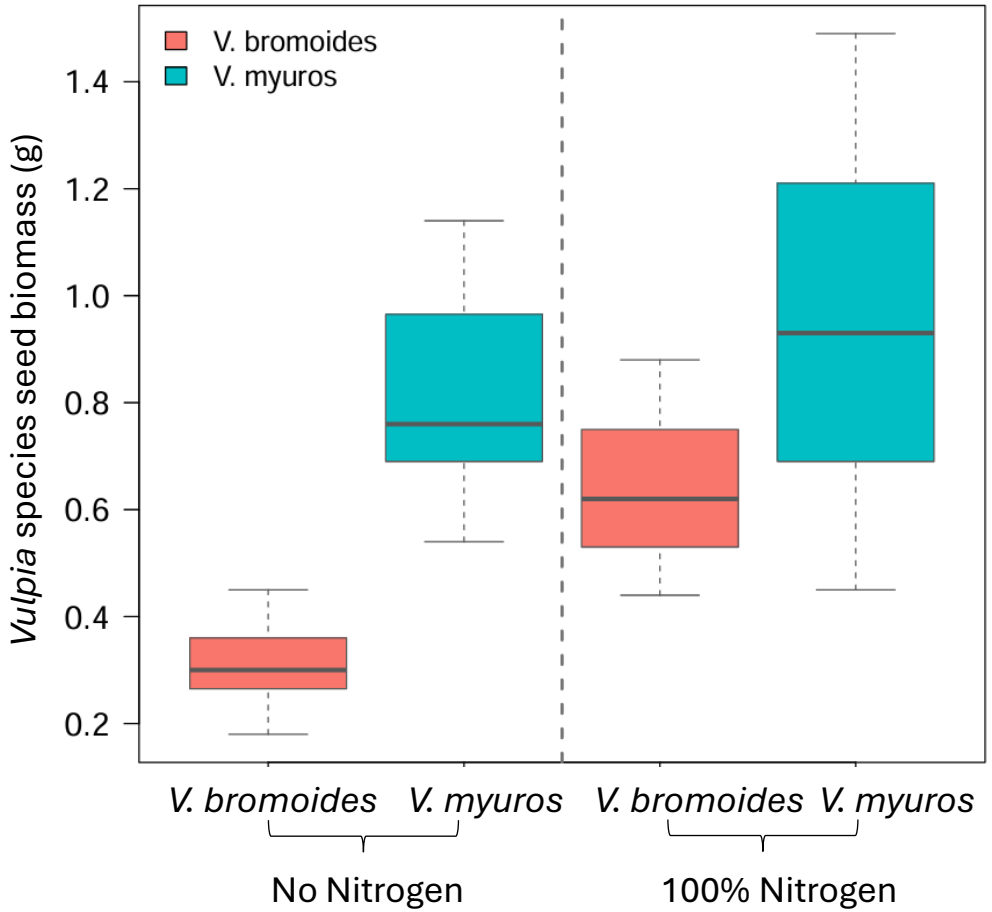
***V. myuros* produced more aboveground biomass than *V. bromoides*.**

Nitrogen addition increases biomass in both species, particularly *V. bromoides*.

Species: p=0.028;
N treatments: p=0.049;
Plant × N: p=0.273

Seed biomass (g) at maturity

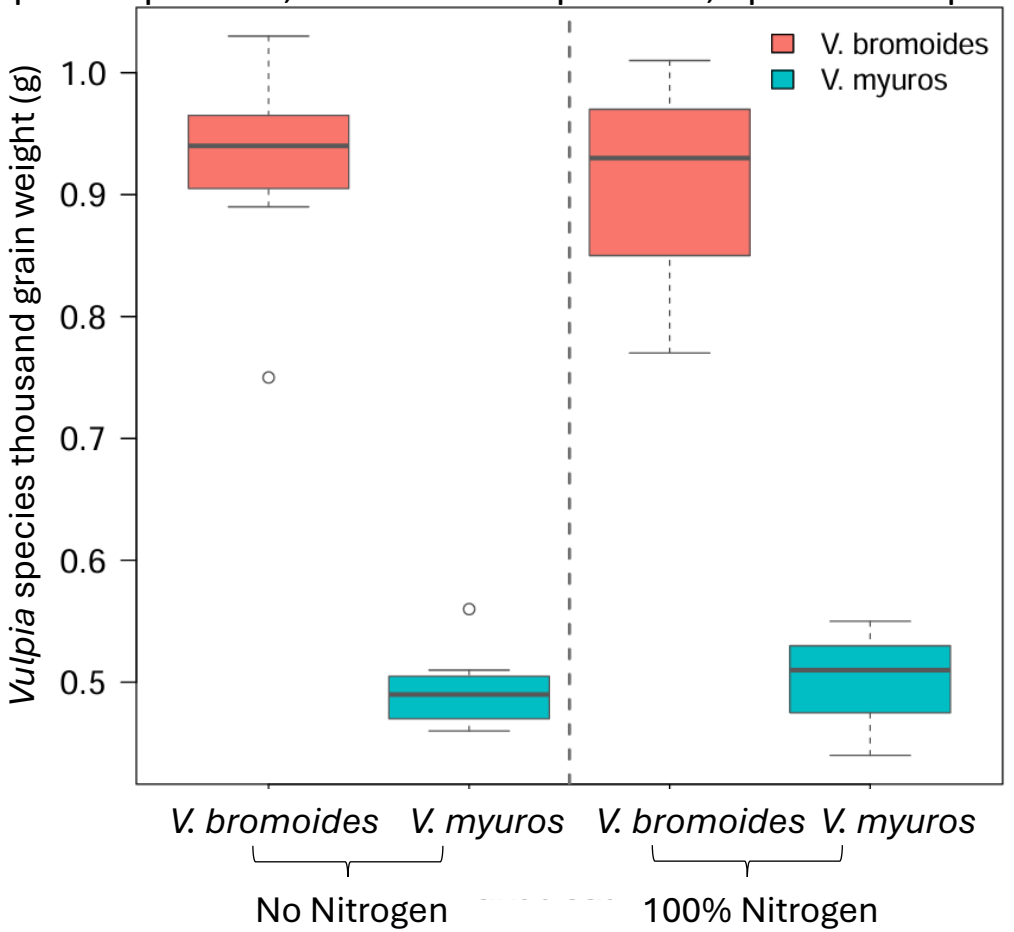
Species: p<0.001; N treatments: p= 0.273; Species × N: p= 0.414



V. myuros produced greater seed biomass than _V. bromoides_, No response to N

Thousand grain weight (g)

Species: p<0.001; N treatments: p= 0.853; Species × N: p= 0.735



V. bromoides produced heavier individual seeds; the N effect was not significant.

Competition experiment | Experimental design

Growing seasons
2024-25 and 2025-26

Setting
Semi-controlled greenhouse conditions

Crop
Winter wheat

Cropping treatments

01 Wheat alone

02 Wheat + *V. myuros*

03 Wheat + *V. bromoides*

Nitrogen treatments

N0 No Nitrogen

N1 25% Nitrogen

N3 50% Nitrogen

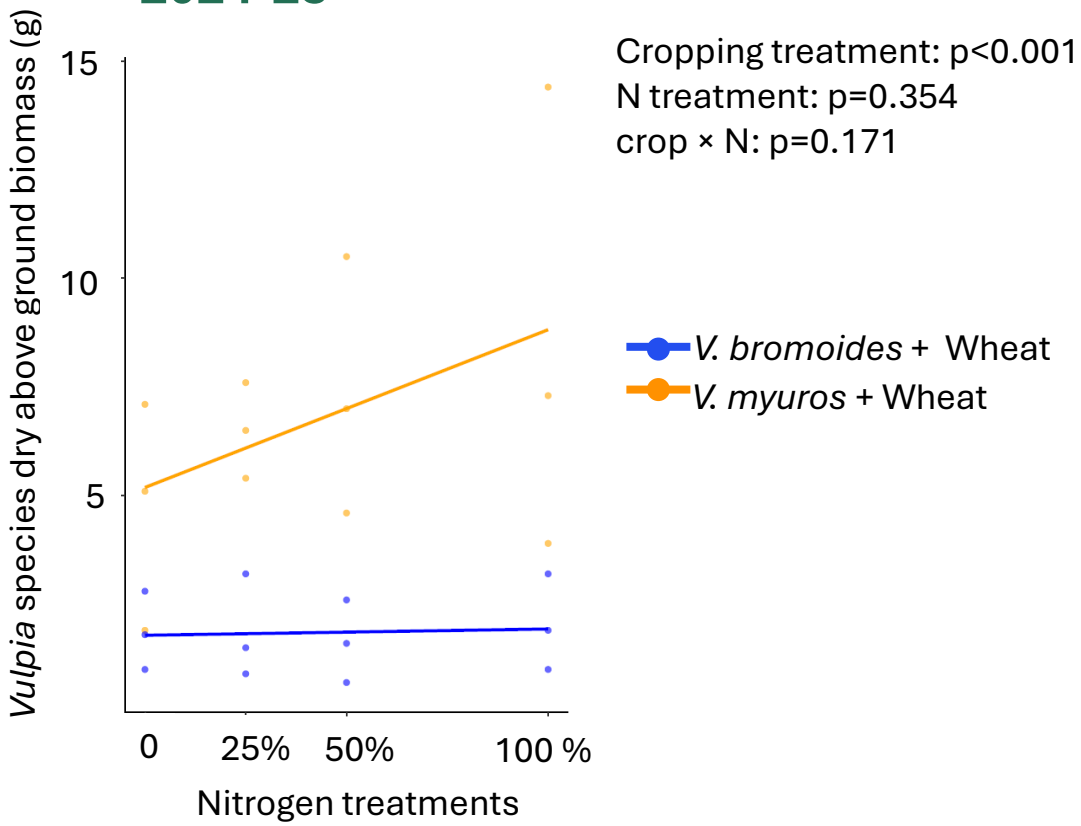
N4 100% Nitrogen

Nitrogen application timeline (Spring application)

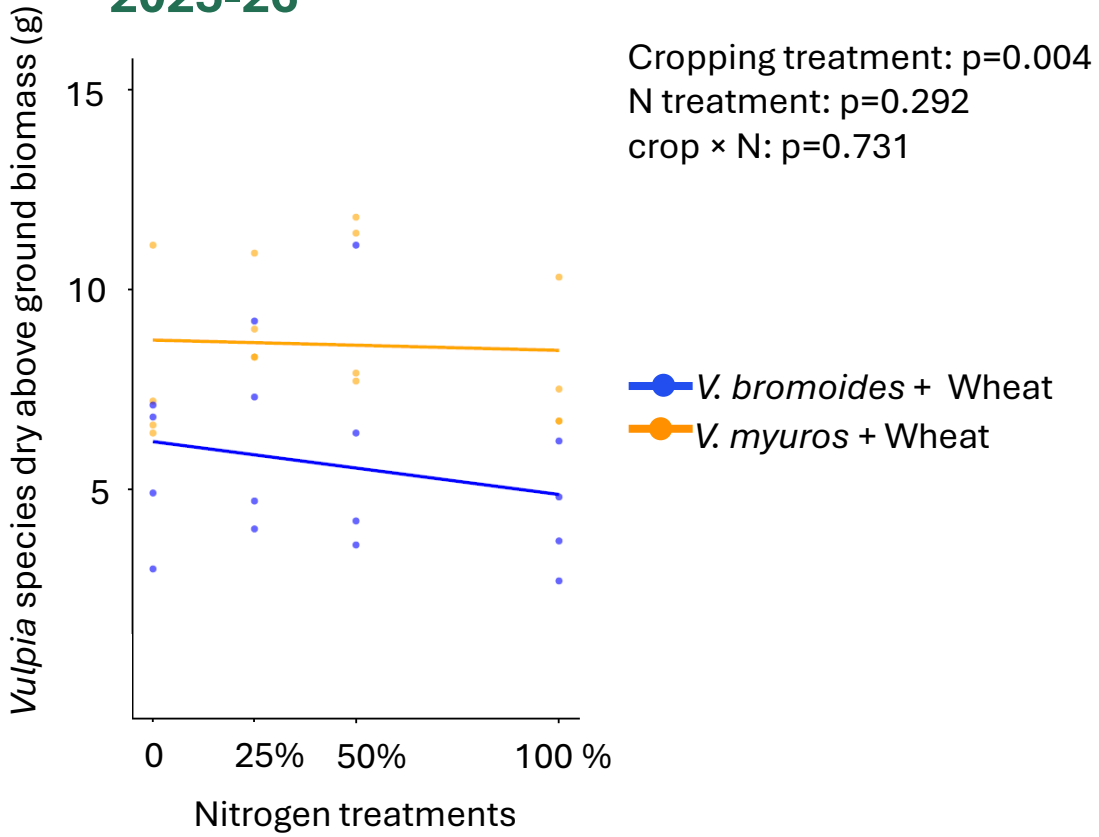
- October Sowing
- First node is detectable 196 DAS (30% dose)
- Third node is detectable 206 DAS (40% dose)
- Ear emergence 215 DAS (20% dose)
- Before seed formation 225 DAS (10% dose)

Vulpia aboveground biomass under wheat competition

2024-25



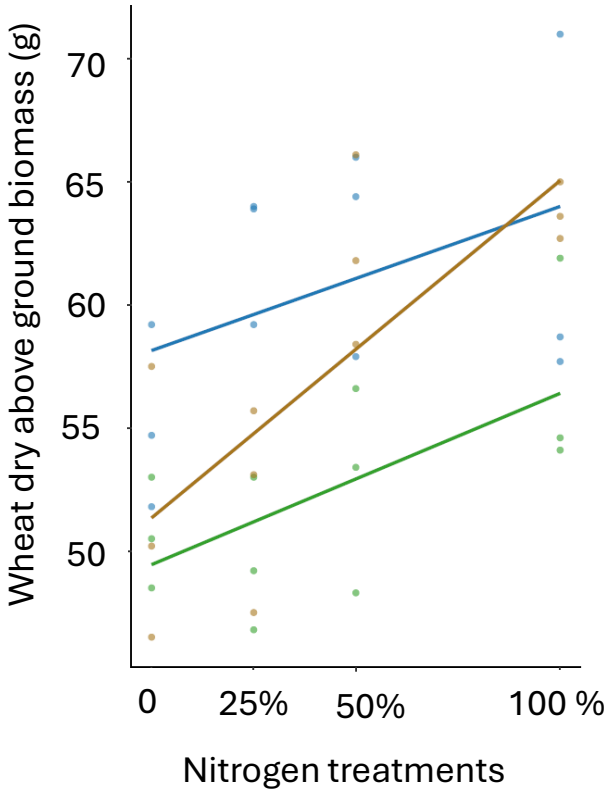
2025-26



***V. myuros* had greater aboveground biomass under wheat competition in both seasons. No response to N treatments.**

Wheat aboveground biomass at maturity under competition

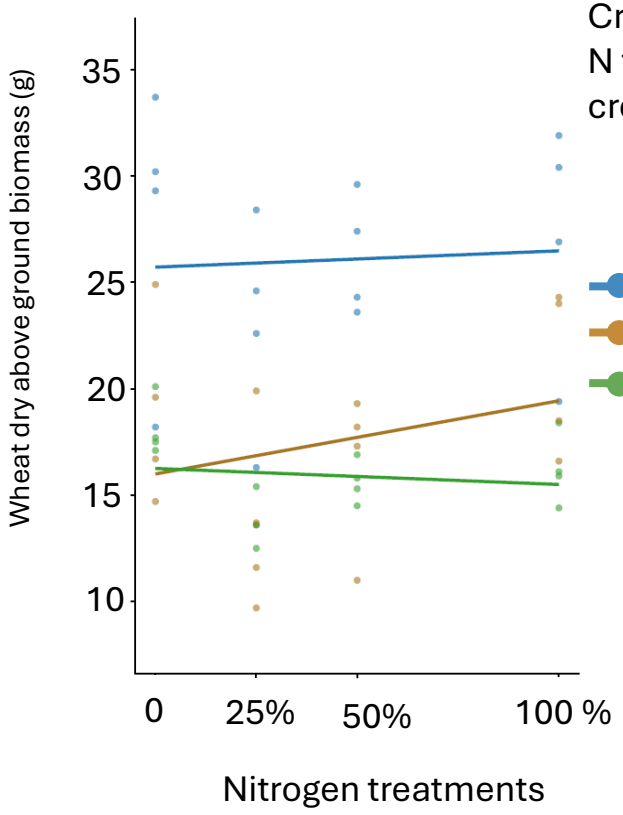
2024-25



Cropping treatment: p<0.001
N treatment: p<0.001
crop × N: p=0.504

Wheat	a
V. bromoides + Wheat	ab
V. myuros + Wheat	b

2025-26



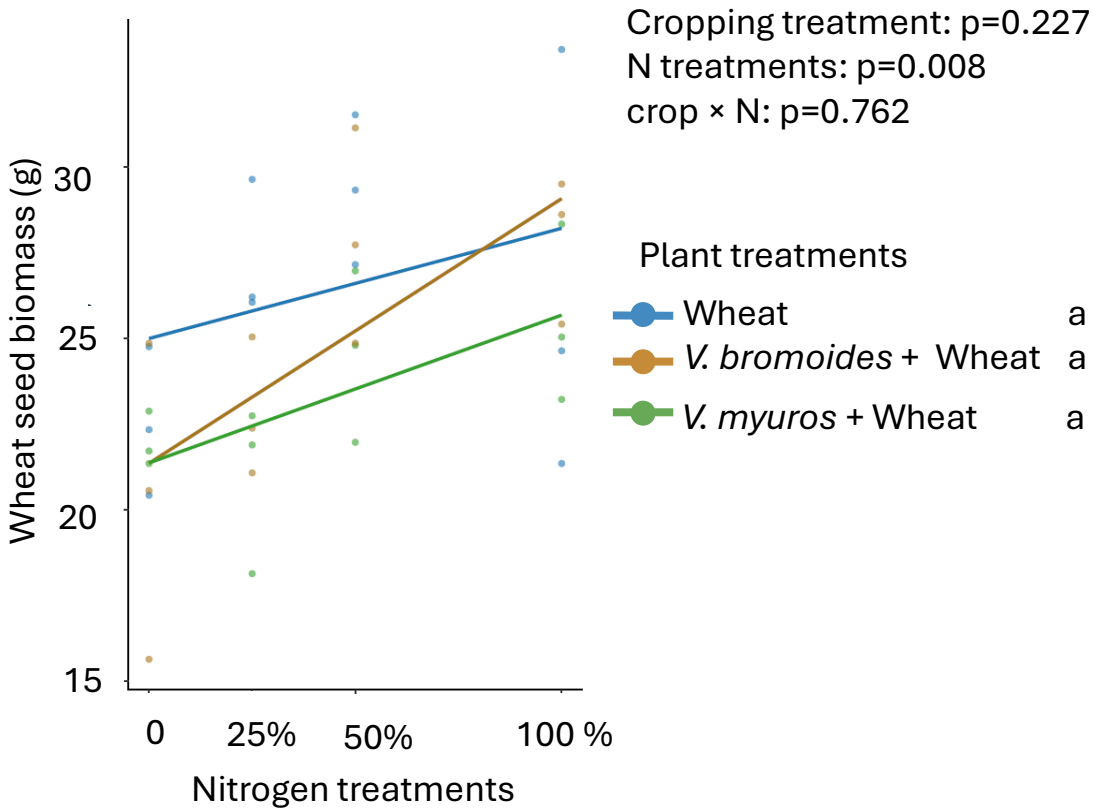
Cropping treatment: p<0.001
N treatments: p=0.677
crop × N: p=0.623

Wheat	a
V. bromoides + Wheat	b
V. myuros + Wheat	b

Strong effect of *Vulpia myuros* presence than *Vulpia bromoides*. N increased wheat biomass 2024-25.

Wheat seed biomass under competition

2024-25

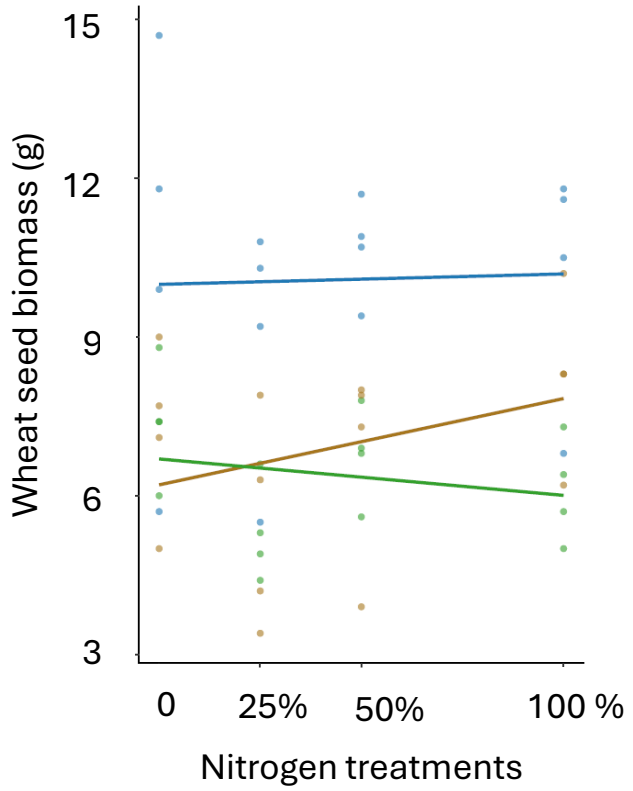


Cropping treatment: p=0.227
N treatments: p=0.008
crop × N: p=0.762

Plant treatments

Wheat	a
V. bromoides + Wheat	a
V. myuros + Wheat	a

2025-26



Cropping treatment: p<0.001
N treatments: p=0.752
crop × N: p=0.528

Plant treatments

Wheat	a
V. bromoides + Wheat	b
V. myuros + Wheat	b

In 2024-25, no effect of competition; In 2025-26, competition from both species

Farmer survey: Understanding the agricultural niche of *Vulpia myuros*

Western European farmer survey

Online Questionnaire

471 farmers across six Western European countries

Information collected

Cropping, tillage, weed management and reported occurrence

Check for updates

Weed Research

WILEY

ORIGINAL ARTICLE OPEN ACCESS

Practices and Challenges Associated With *Vulpia myuros* Infestations in Western European Arable Systems

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Published in Weed Research (Bibi et al., 2026)

Farmers report substantial *Vulpia myuros* management challenges

Survey responses from farms reporting *V. myuros*

65%

found *V. myuros* difficult to control

34%

expected yield loss

20%

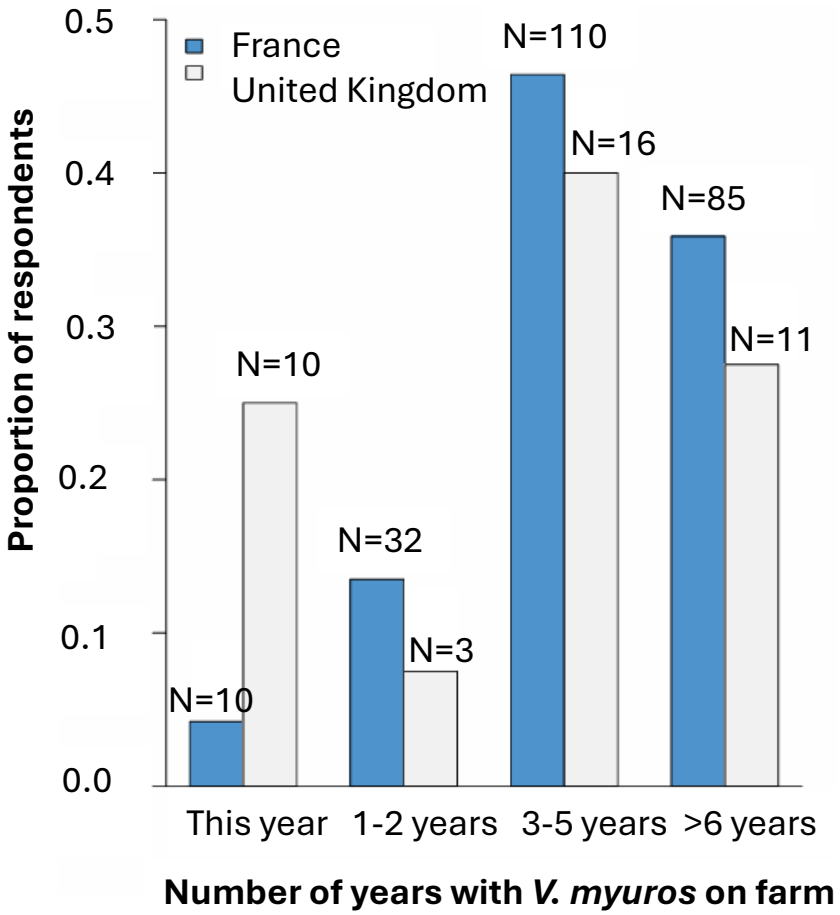
reported infestation across >25% of field area

Key message: Control difficulties are common, even though only about one-third expect yield losses.

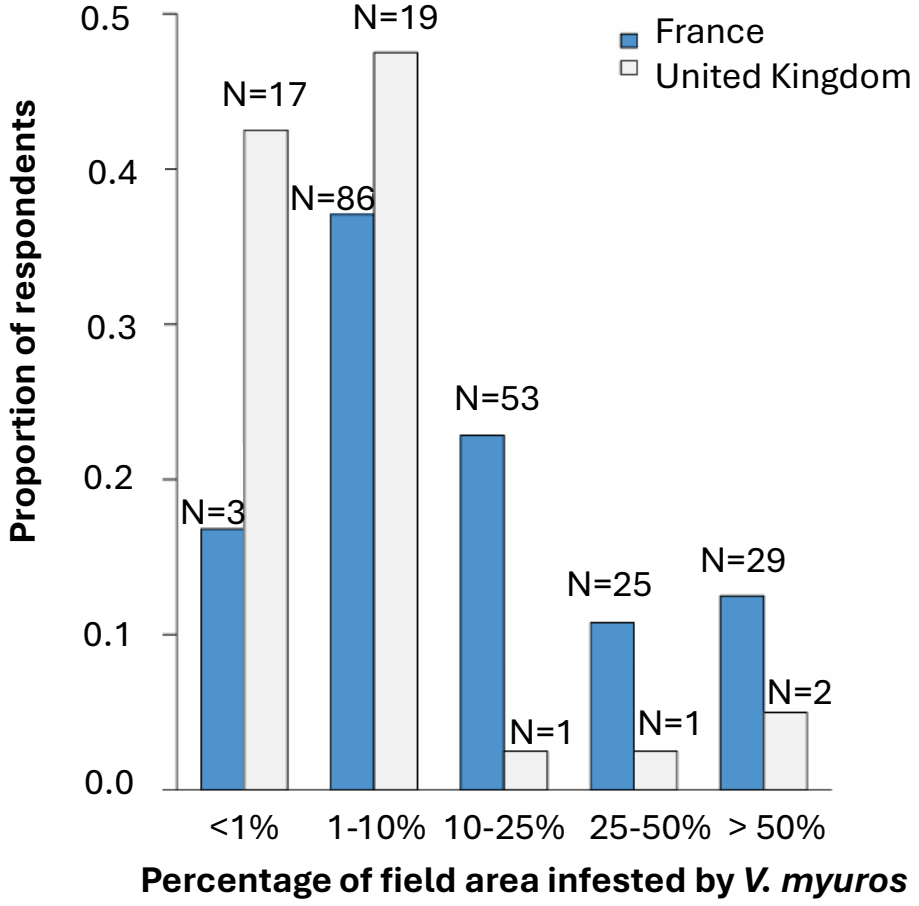
Self-reported survey findings; not causal estimates.

Vulpia myuros infestations differ between France and the UK

A | Duration of infestation



B | Field area affected



French respondents reported longer-established and more extensive *V. myuros* infestations than UK respondents.

CONCLUSIONS

What contributes to the contrasting agricultural success of *Vulpia* species?

01 **Environmental context**
Habitat suitability may influence their contrasting distributions and potential establishment.

02 **Biological traits**
Greater reproductive output and competitive performance may contribute to the success of *V. myuros*.

03 **Farm survey context**
V. myuros is already an established arable weed, with substantial infestations and reported control difficulties.

TAKE-HOME MESSAGE | Habitat suitability may shape where *Vulpia* species establish, but differences in reproductive and competitive performance may help explain their contrasting agricultural success.

Thank you!

Any questions?



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