



V Congreso Argentino de Malezas • ASACIM

MALEZAS 2026

Ciencia, producción y sociedad: hacia un manejo sustentable

HOTEL QUINTO
CENTENARIO
CÓRDOBA

2y3
SEPTIEMBRE



COORDINACIÓN
GENERAL



Round table “Neutral or Non-Detrimental Weed Communities”

“Can planned biodiversity in chickpea crops shape a non-detrimental weed community?”

View on mobile



Stefano Carlesi (Scuola Superiore Sant’Anna, SSSA)

Anna Rizzolo (Scuola Superiore Sant’Anna, SSSA)

Cordoba 2 September 2026



Sant’Anna
School of Advanced Studies – Pisa

Chickpea (*Cicer arietinum* L.)

the third most widely cultivated grain legume worldwide and the second most consumed in the global human diet (FAO, 2024)

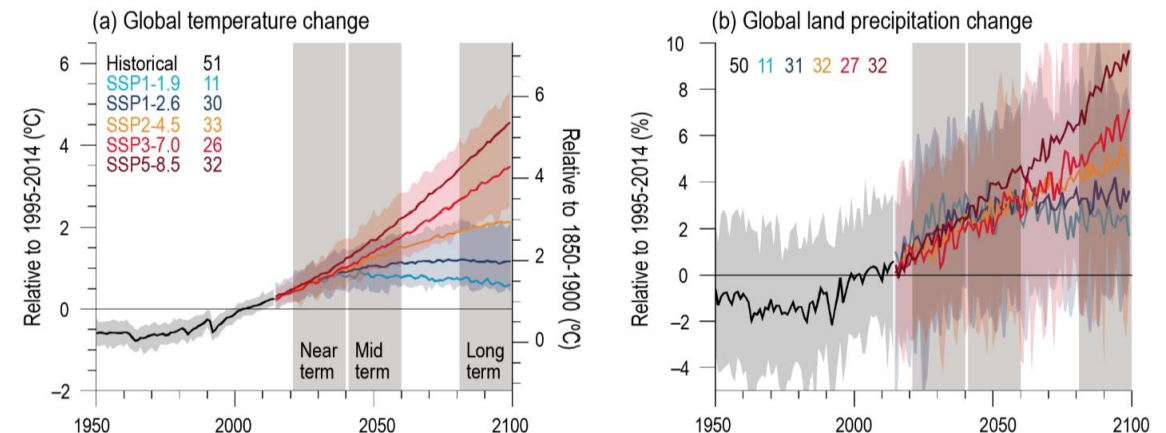
>Global production exceeded 17 million tonnes in 2024

>High protein content (20–25%), essential for food security in semi-arid regions

>Relative drought tolerance.



- Italy is the second largest producer of chickpeas in Europe.
- Climate instability – drought and flooding conditions are becoming increasingly frequent.
- Chickpeas face different types of stress: **Weed competition**, Biotic stress (fungal disease) and abiotic stress (drought).



A critical vulnerability: weed competition

chickpea is **poor competitor** (Khan et al., 2023):

Slow early growth and limited leaf development

Delayed canopy closure

Greater vulnerability during early phenological stages

Yield losses due to weeds:

Range between **24% and 88%**, depending on weed density (Veisi et al., 2020)

The **critical competition period** is between **35 and 60 days after emergence**(Merga et al., 2019)





General aim

- **Functional use of planned diversity** can enhance the **sustainability** and **resilience** of chickpea cropping systems under changing climatic conditions?

- **Specific goals:** Test **cultivar mixtures** as a strategy to exploit intraspecific diversity and improve system stability (drought, Fusarium wilt and weed competition).

- **Weed focus:** Assess if combining crop CV with specific and different traits may shape weed composition during the crop growth

Not
weed
specific



Scientific questions

- Q1: Crop Cv Identity vs. Mixture Type vs. Pure CV Richness — What drives weed response?
 - Q2: Biomass & Complementarity — How to quantify the mixture effect?
 - Q3: Functional Filtering — we may aim at a less detrimental weed traits?

Experimental Design

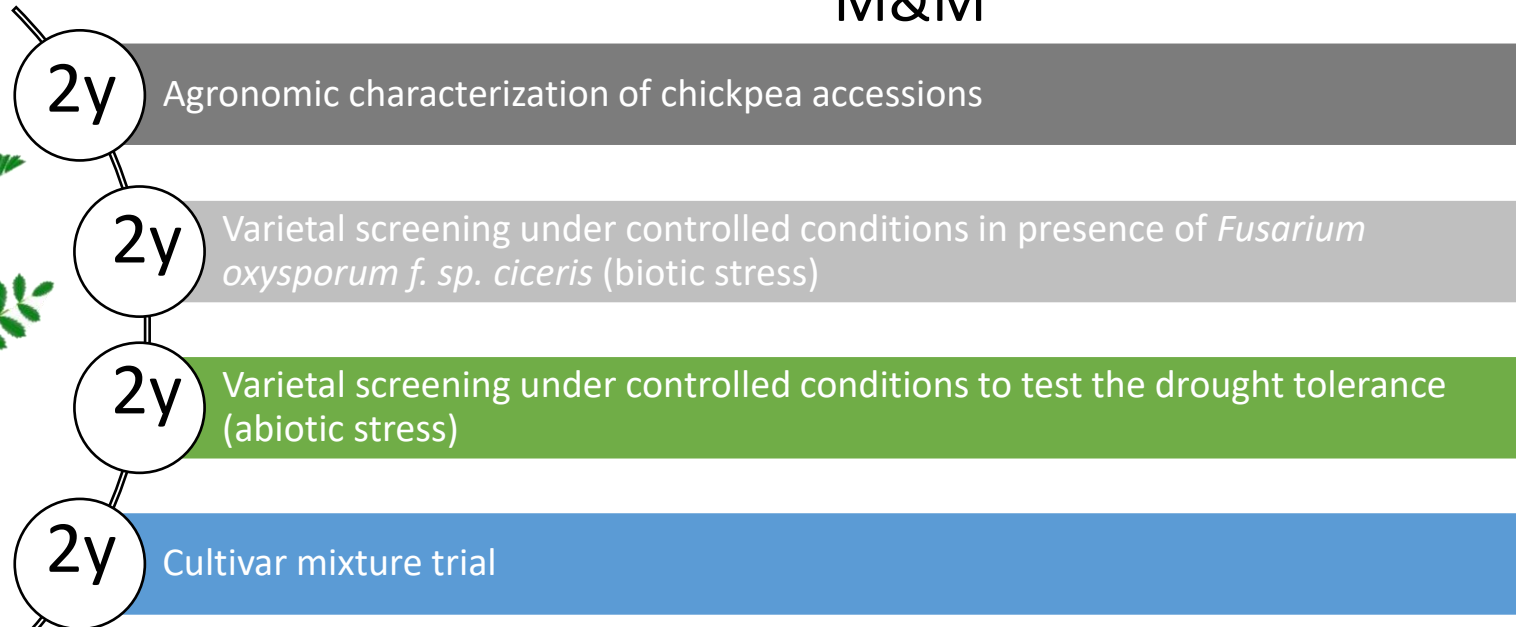
4 Mixture Types (A–D) = 4 breeding pools

- Richness levels: 1, 2, 3, 4 cultivars
- All combinations: 15 compositions per type
- Blocks: 3 reps × (2 years - 2 fields) = 6 blocks
- Responses: weed biomass, species composition, 8 traits,
Species Richness, Shannon Index, RaoQ, Functional dispersion

Scientific opportunities

as far as we know there is no studies on chickpea functional biodiversity (CV mixture) and on weed assemblage in particular.

Accession	Name	Functional Traits	Description	Fusarium Tolerance	Drought Tolerance	Habitus	Height	Productivity	Mix Type
1	RUG	FT	Fusarium Tolerant	1	0	1	0	0	C
3	PVE	TP	Tall Productive	0	0	1	1	1	A
5	VAL	DT-T	Drought Tolerant -Tall	0	1	1	1	0	B
6	LON	FT-S	Fusarium Tolerant- Small	1	0	1	1	0	B C
12	ESP	FT	Fusarium Tolerant	1	0	1	0	0	C
13	NER	FT-T	Fusarium Tolerant- Tall	1	0	1	1	0	B C
17	SUL	DT	Drought Tolerant	0	1	1	0	0	D
18	MRG	DT-S	Drought Tolerant -Small	0	1	1	1	0	B D
32	BGR	E	Erect	0	0	2	0	0	A
44	MAR	SP	Small Productive	0	0	1	1	1	A D
49	ITA	DT	Drought Tolerant	0	1	1	0	0	D
53	CYP	P	Prostrate	0	0	0	0	0	A



Cultivar mixtures assembly

Group A: contrasting growth habit and plant height, considering their yield performance in the previous year.

Group B: assembled to maximize complementarity in stress tolerance (*Fusarium* presence and drought) and niche occupation

Group C: assembled to ensure redundancy for the trait of tolerance to *Fusarium oxysporum f. sp. ciceris*.

Group D: assembled to ensure redundancy for the trait of drought tolerance.

Sampling and measurements:

- Crop Density and canopy cover
- weeds composition % of cover 1 month before harvesting and biomass at harvest
- disease presence & total yield



ITALIA		BLOCCO 1										PSA	
0.2	0.8	0.2	0.8	0.2	0.8	0.2	0.8	0.2	0.8	0.2	0.8	0.2	0.8
MAR	A	PVE	SUL	VAL	SUL	RUG	VAL	VAL	VAL	VAL	VAL	E	
ITA	D	BGR	MRG	NER	MAR	SPA	NER	LON	MRG	MRG	MRG		
		CYP	MAR	NER									
MRG	BRG	NER	LON	VAL	LON	MRG	LON	LON	LON	LON	LON	RUG	
MAR	CYP	MRG	NER	NER	NER	ITA	SPA	MRG	MRG	MRG	MRG	LON	
ITA													
SUL	PVE	SUL	PVE	RUG	MAR	PVE	SUL	LON	A				
ITA	MAR	MRG	BGR	NER	CYP	BGR	ITA	NER	B				
MAR	CYP												
RUG	VAL	VAL	RUG	VAL	PVE	BGR	RUG	RUG	C				
LON	LON	LON	SPA	MRG	MAR	MAR	LON	LON	D				
SPA	MRG	NER	NER			CYP	NER						
MRG	PVE	SUL	LON	SPA	SUL	PVE	A	BGR	A				
MAR	CYP	MRG	ITA	NER	ITA	MAR	C	MAR	B				
									C				
									D				

Field trial 2024

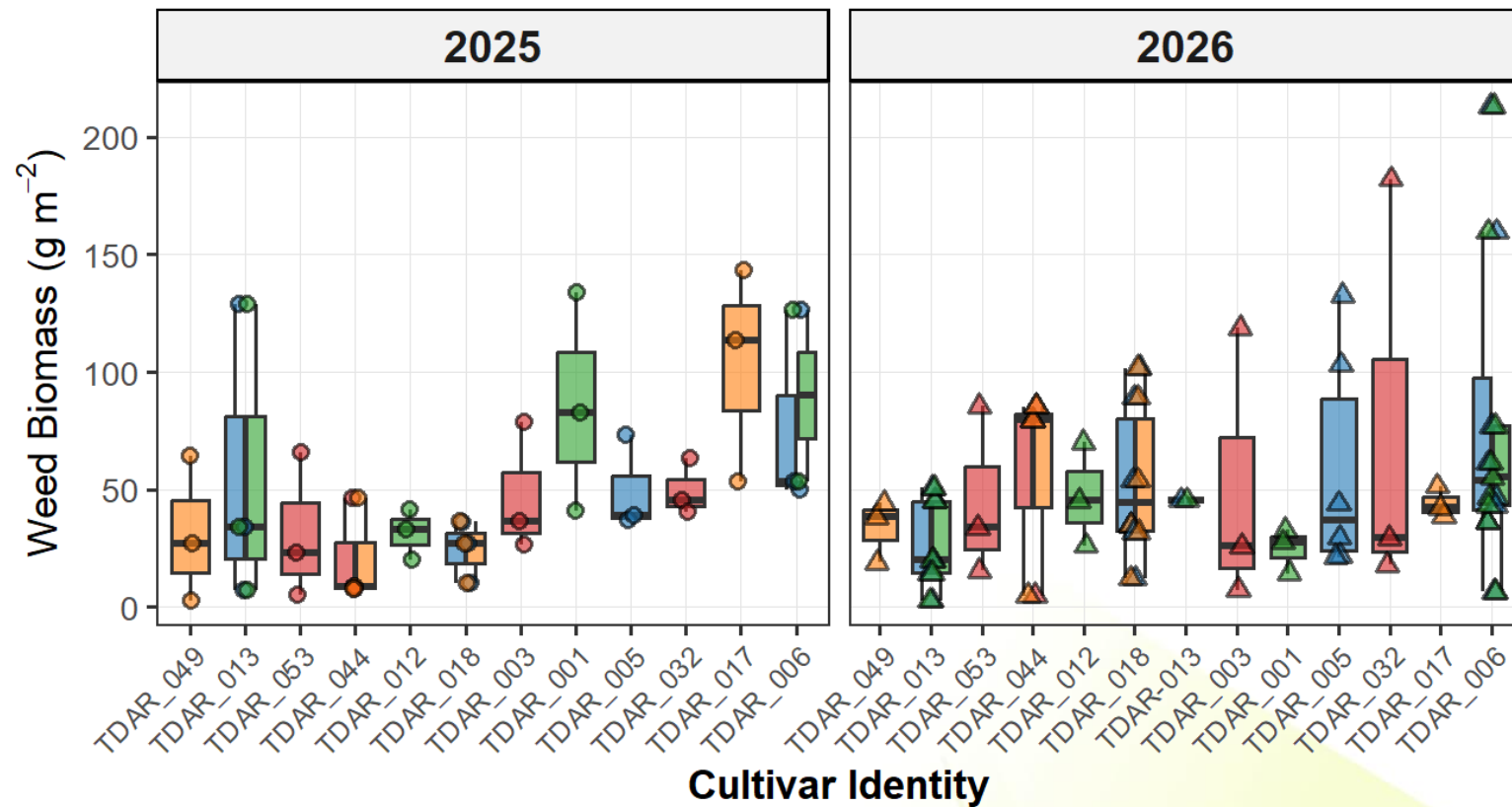
Results

Q1: Crop Cv Identity vs. Mixture Type vs. Pure Richness What drives weed response ?

CV Identity Drives Weed Biomass More Than Mixture Type

Single-CV plots | CV identity $R^2m = 0.21$ vs Mixture Type $R^2m = 0.009$

- CV identity $R^2m = 0.21$
- Mixture Type $R^2m = 0.009$
- AIC: 1097 vs 1242
- Which CV >> Which pool



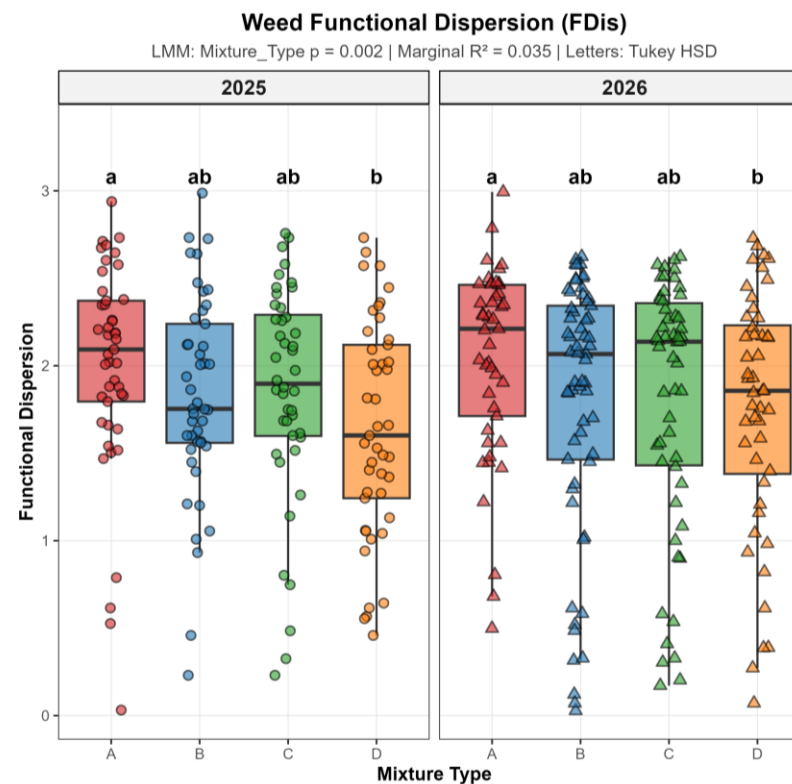
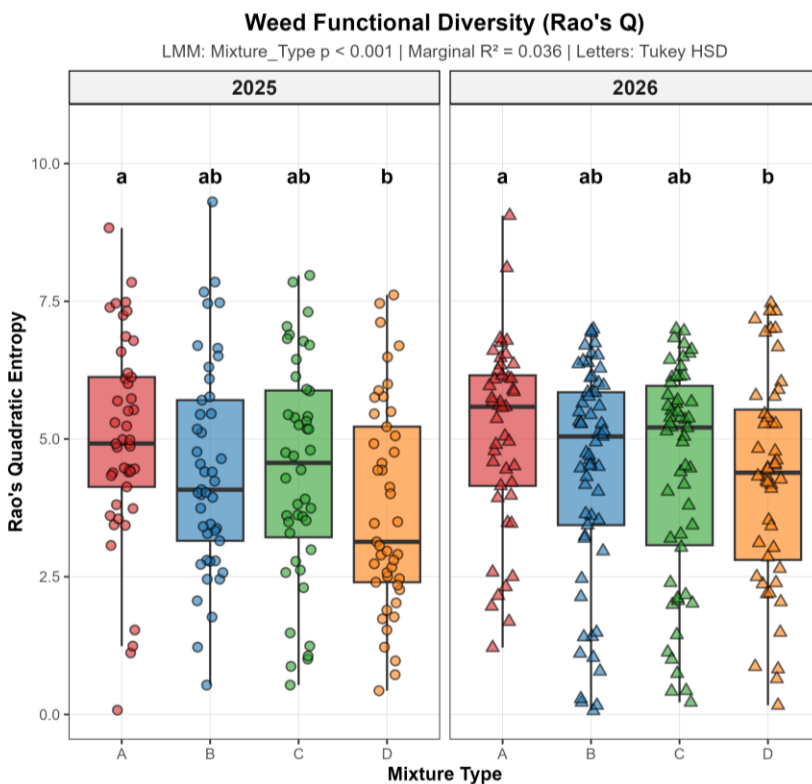
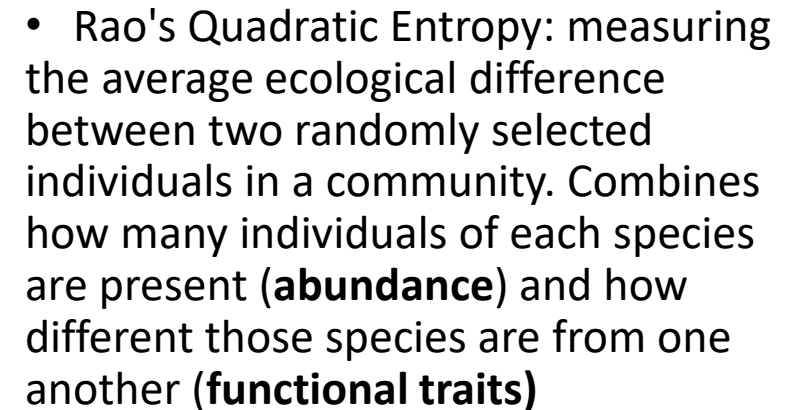
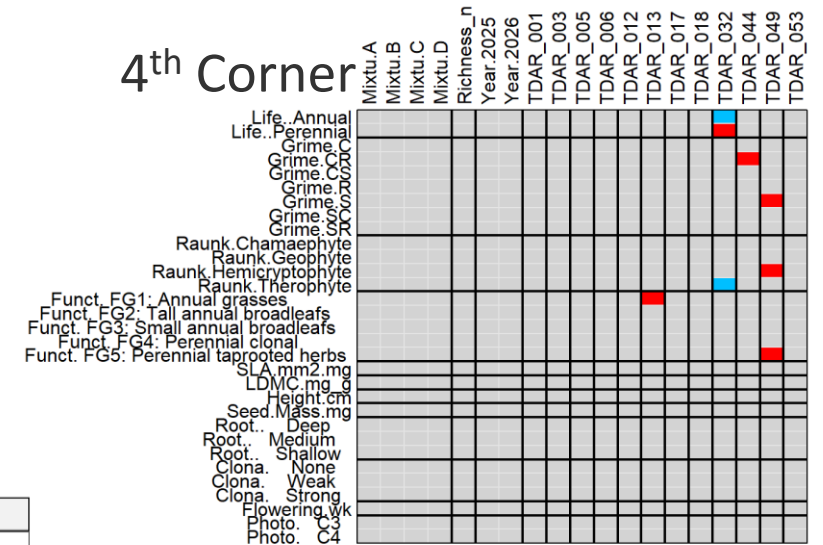
Mixture Type A B C D

Year 2025 2026

Results Results & Discussion

Q1: Crop Cv Identity vs. Mixture Type vs. Pure Richness

What drives weed response ?



Year ○ 2025 △ 2026

Results & Discussion

Q2: Biomass & Complementarity

How to quantify the mixture effect?

Effect of Cultivar Richness on Weed Suppression Deviation

Separate slopes for each Mixture Type and Year

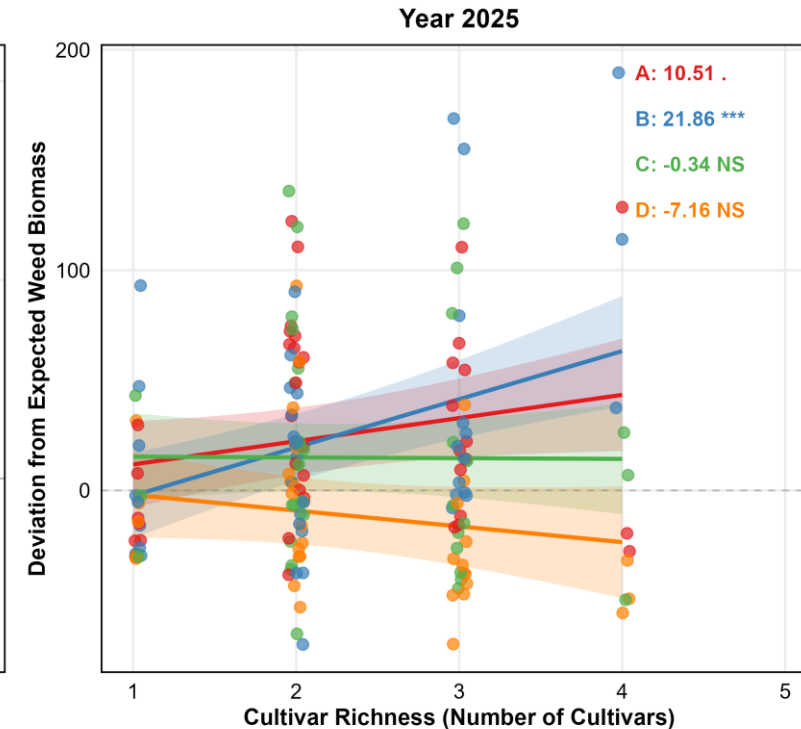
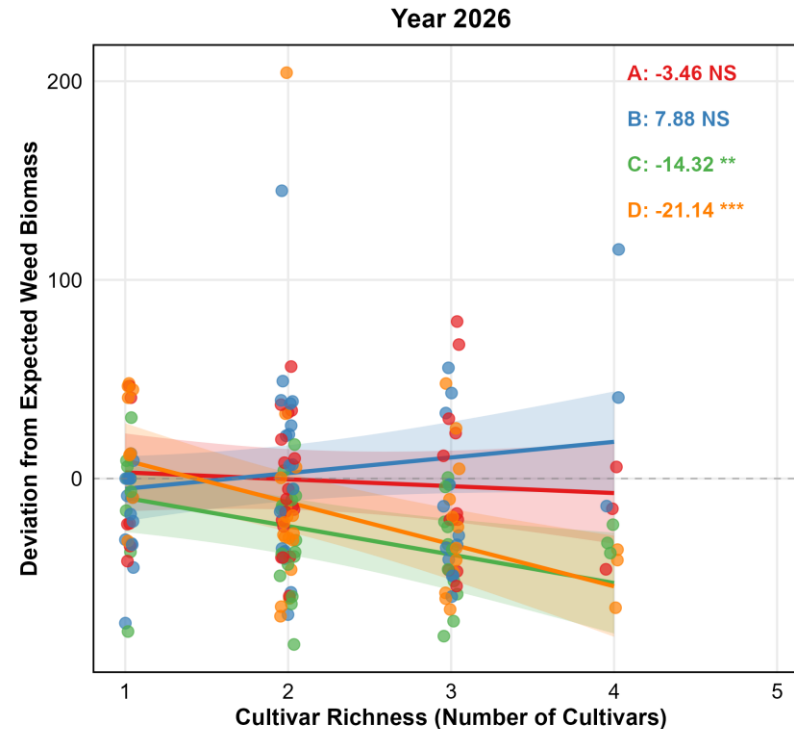
- LMM: ExpectedBio: Mix Type x Richness
 $p < 0.001$

- Not just averaging singles

- Complementarity effect

- Observed < Expected → mixtures do MORE than singles

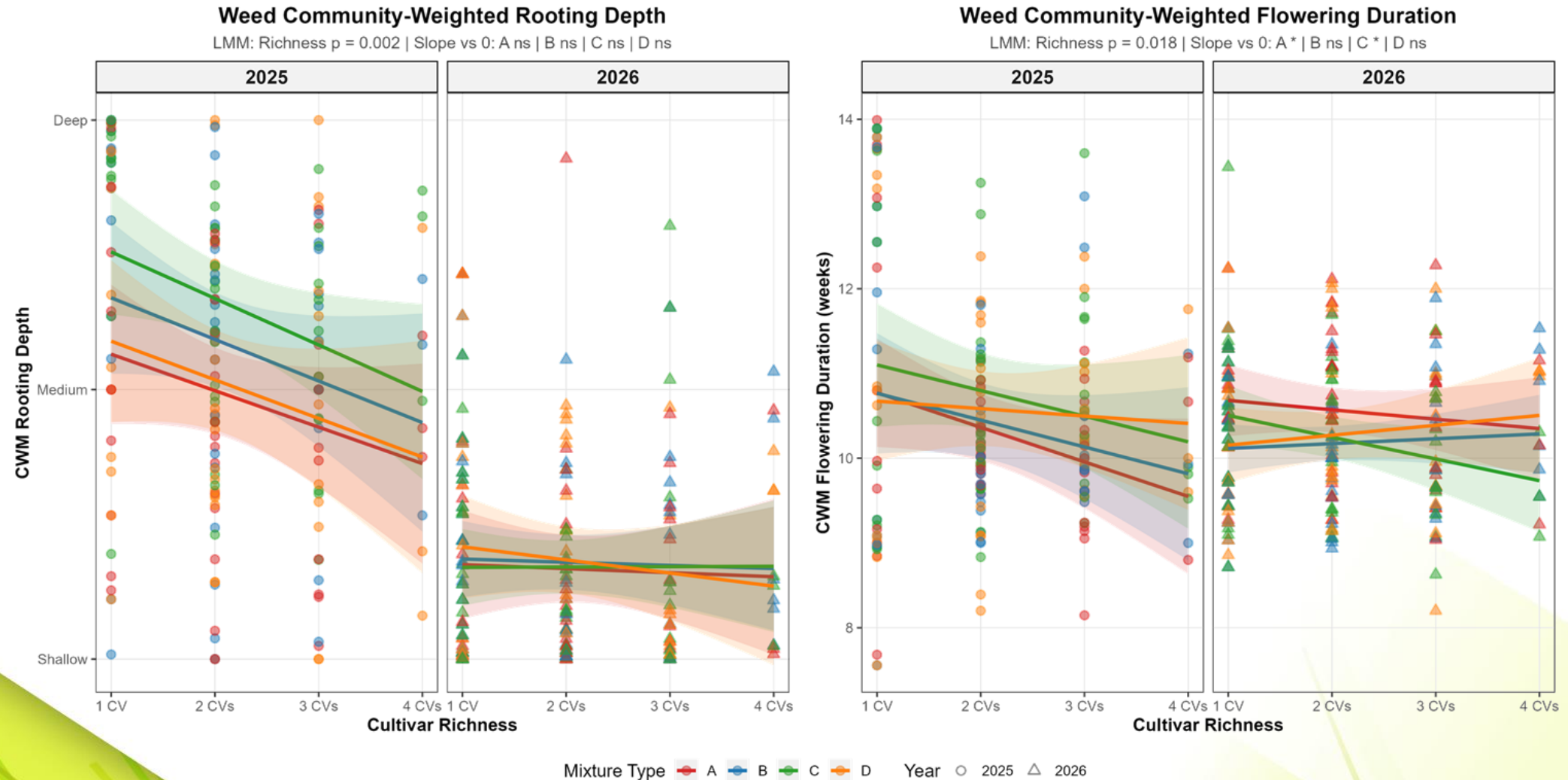
One clear exception: mixture B
(complementary trait for biotic and abiotic stress) in 2025 (not stressed)



Results & Discussion

Q3: Functional Filtering

We may aim at a less detrimental weed traits?



Results & Discussion

Q3: Functional Filtering

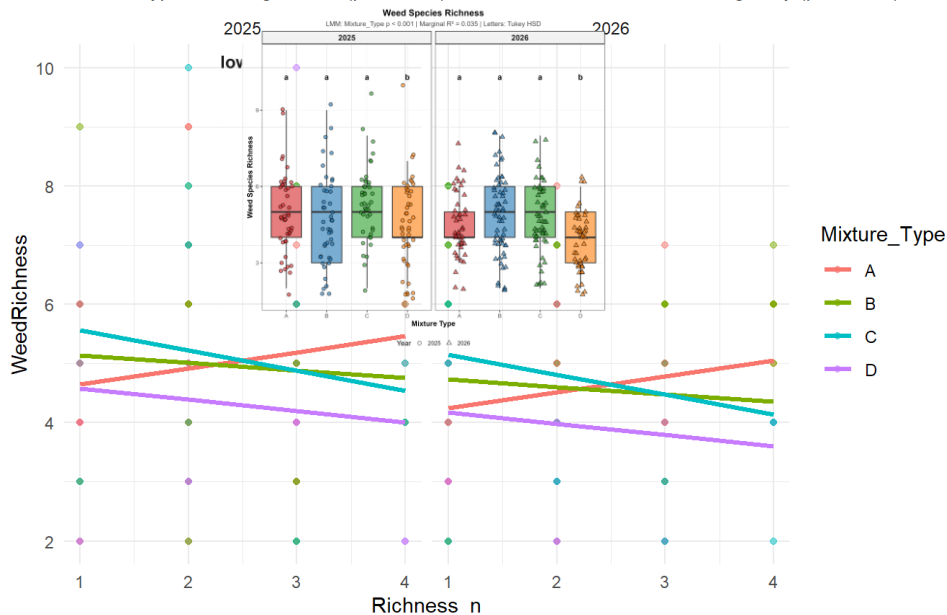
We may aim at a less detrimental weed traits?

More weed diversity in certain mixture types (A: complementarity and productivity)

- More niches = more weed species
- But functionally diverse, not more competitive

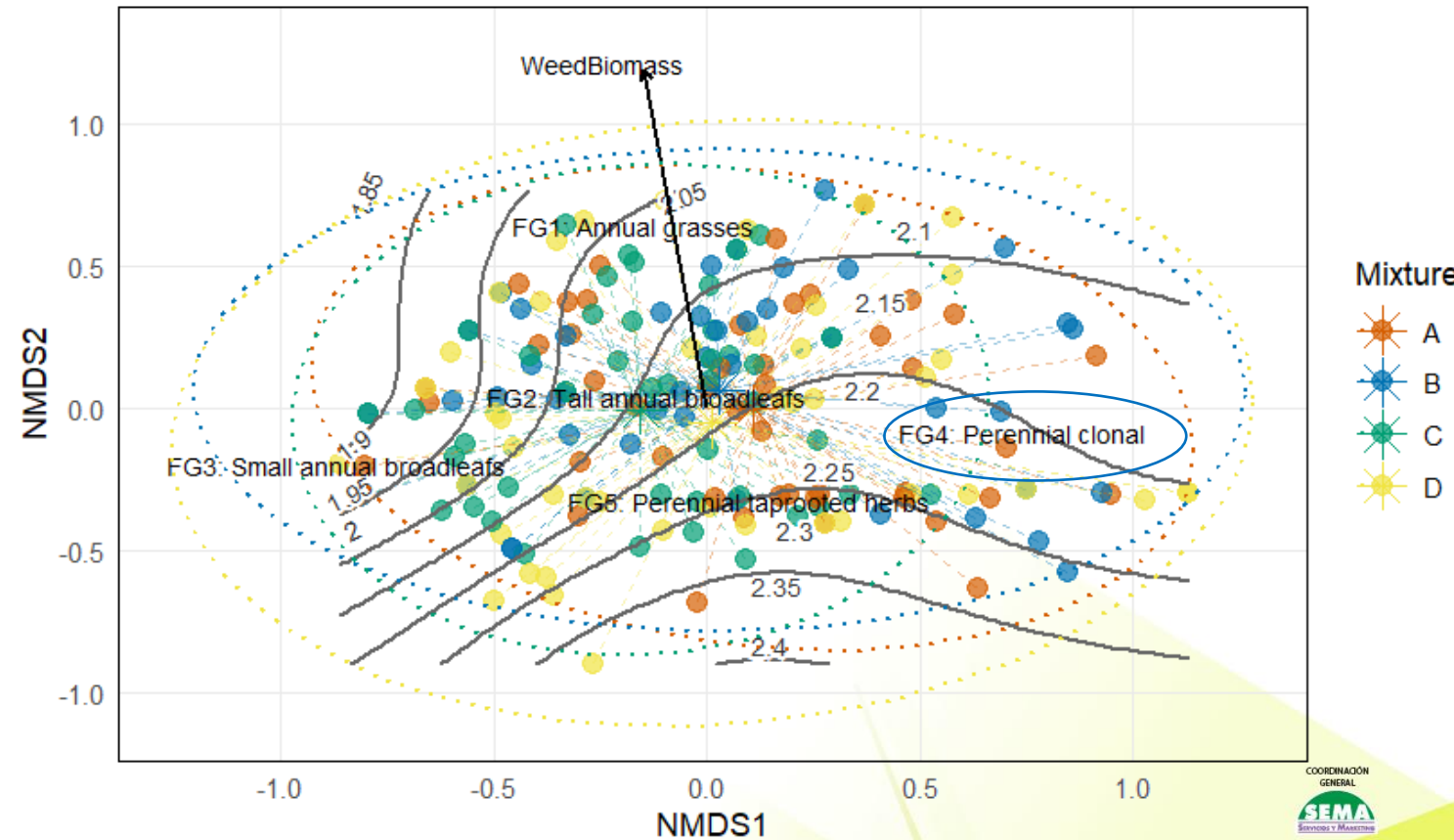
Weed Species Richness vs. Cultivar Richness

Mixture Type effect significant ($p < 0.001$); interaction with Richness marginally ($p = 0.056$)



NMDS of Functional Groups (Year 2025)

Spiders and ellipses by Mixture Type; contours = Richness_n



Conclusion

1. Choose the cultivar first — CV identity explains more variance than mixture type
2. Mix for complementarity — 3-4 CVs suppress beyond additivity in combination
>mix A complementarity of traits, productivity) had the diverse traits composition,
>mix D in drought season reduce weed biomass at increasing level of diversity
3. Filter for function — richness drove trait shifts toward shallower, slower weeds
4. CV diversity *per se* is not an effective tool— CV type determines functional diversity of weeds

Take-home: Planned biodiversity needs deep understanding of CV assemblage to the context, still far to be fully understood

Take-home: Planned biodiversity shapes a more functionally diverse weed community, open opportunity for shaping a non detrimental weed community

Thanks for the availability !



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NEUTRAWEEED
WEED-CROP COEXISTENCE



View on mobile



INSTITUTE
OF PLANT
SCIENCES



Sant'Anna
School of Advanced Studies – Pisa

*Scan to find our projects and activities
(Group of Agroecology)*

