

Improvement of chickpea yield through intercropping with common wheat in two Mediterranean locations

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CONTEXT: Growing interest in plant-based protein and **minor grain legumes** like chickpea (*Cicer arietinum* L.) in Europe.

BUT

Low and instable yield over years due to biotic and abiotic stresses limit the uptake of chickpea by farms



Some factors like the choice of **cultivar**, the **intercropping** with wheat (*Triticum aestivum* L.) and the sowing date could help to increase and stabilise chickpea yield



□ **Place:** experimental fields at CiRAA (Pisa) and UNIUD (Udine)

□ **Cultivars:** 5 cultivars of chickpea (2 Desi and 3 Kabuli)



Castellano



Castor



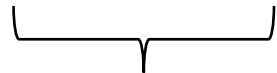
Lambada



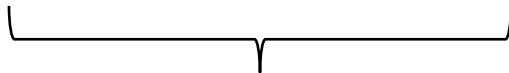
Nero Murgia



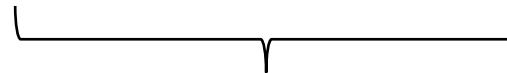
Sultano



Spain



France



Italy

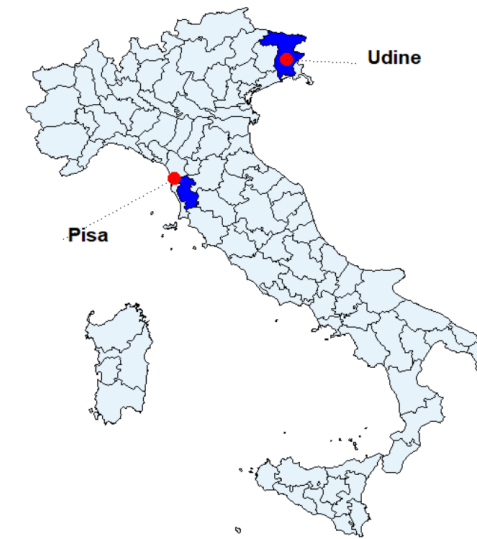
□ **Intercropping:** chickpea (*Cicer arietinum* L.) intercropped with bread wheat (*Triticum aestivum* L.) cv. *Bolero*.

□ **Time:** Simultaneous spring sowing for chickpea and wheat

1 st year (2023)		2 nd year (2024)		Place
Sowing time	Harvesting time	Sowing time	Harvesting time	
22 nd February	24 th July	1 st February	17 th July	PISA
17 th March	1 th August	21 st February	29 th July	UDINE

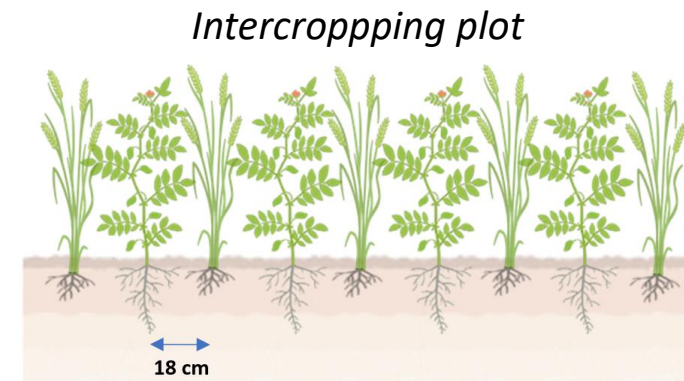
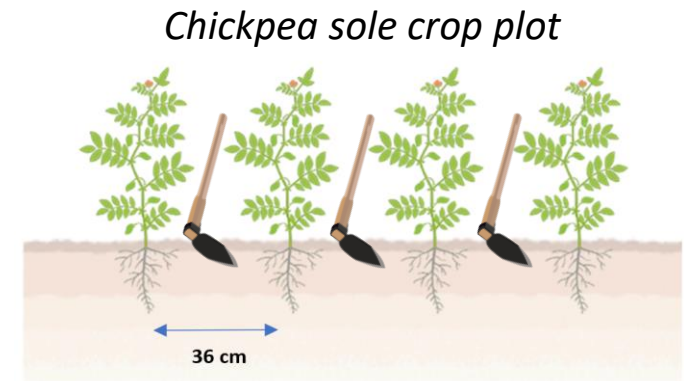
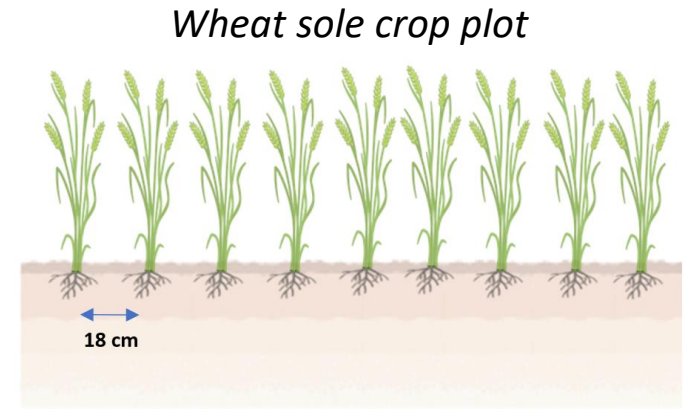
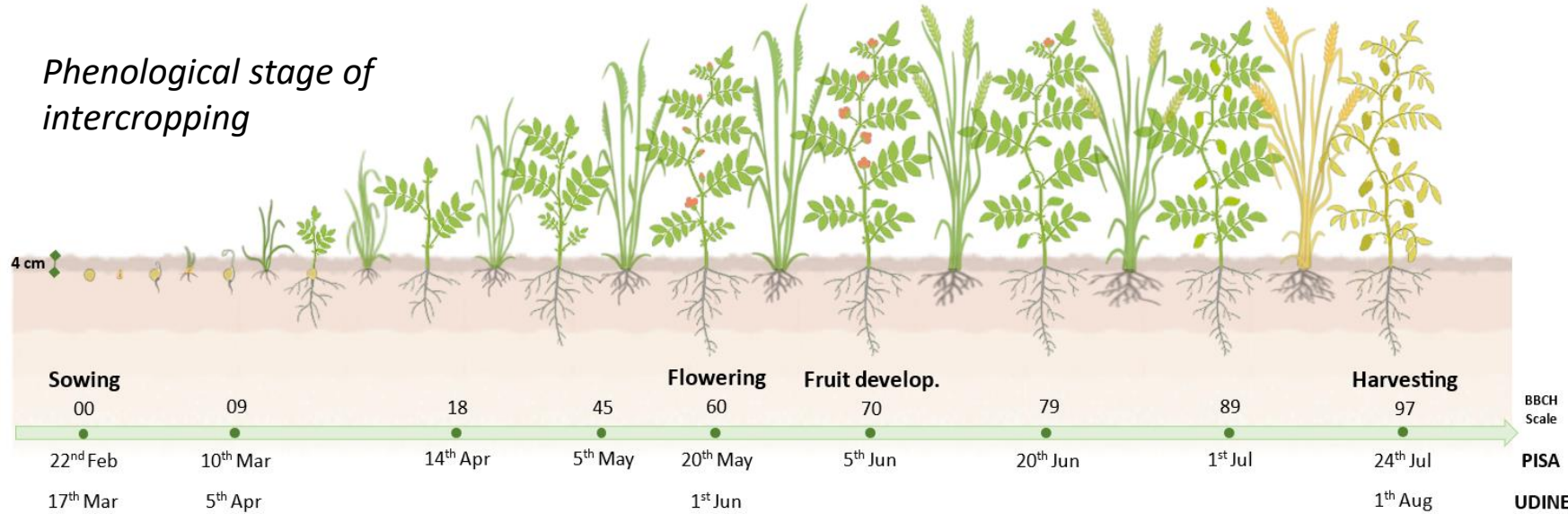


Udine



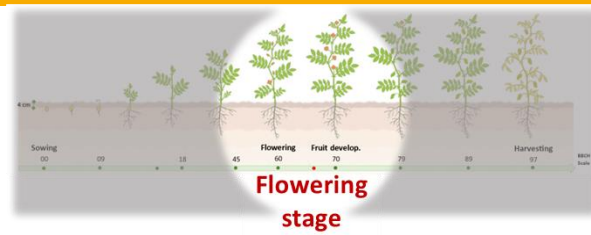
Pisa

Phenological stage of intercropping



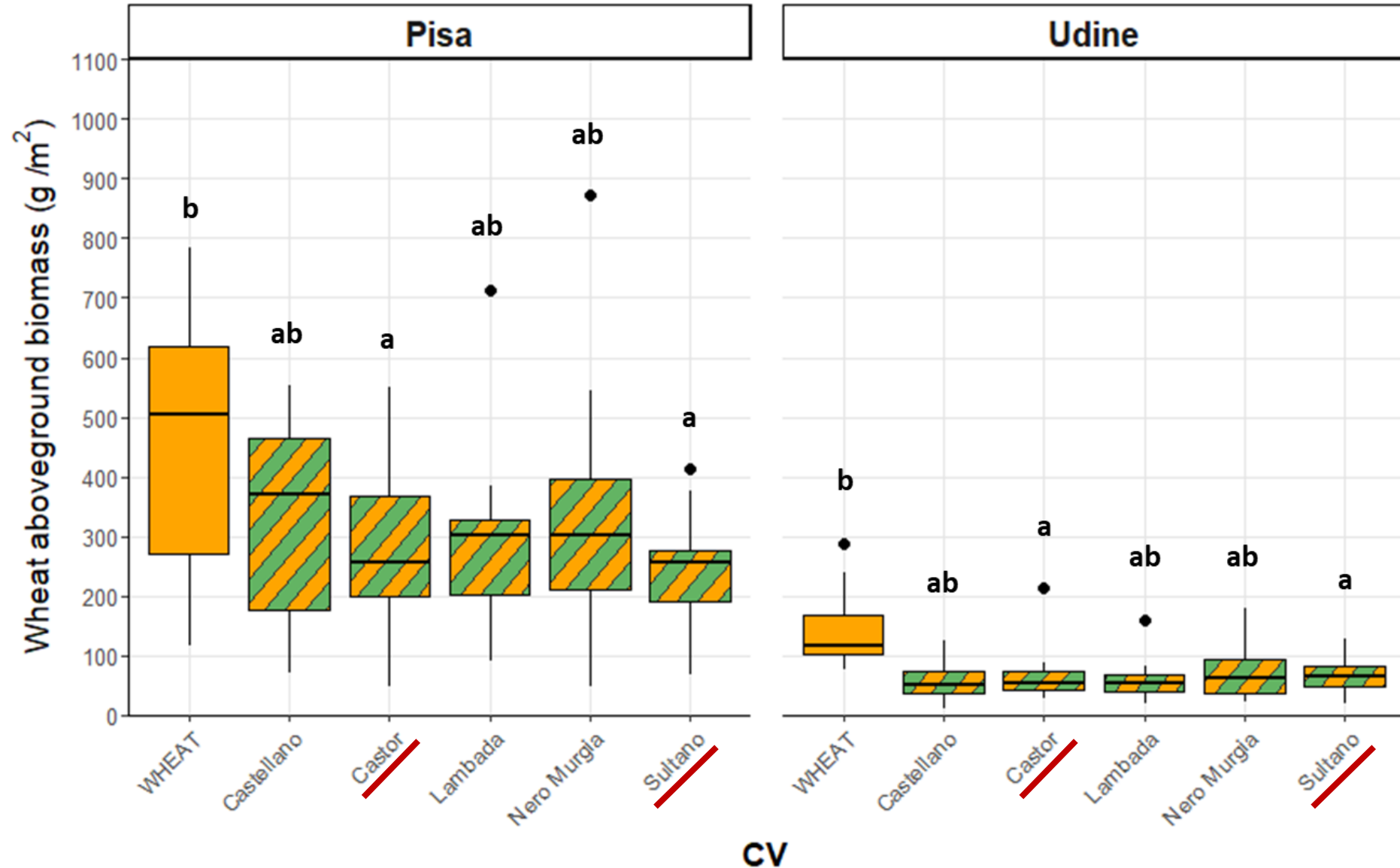
Completely randomized block design with 4 replications done with:

- Sole crop plots → one for each of the 5 chickpea CV (45 plants/m²) + 1 wheat control (400 plants/m²). Chickpea sown at 36 cm row-distance. Mechanical hoeing performed once.
- Intercropping plots → one for each of the 5 chickpea CV (45 plants/m²). Wheat sown in the middle of the chickpea rows. Target seeding density for wheat was 1/3 of the optimal density for wheat (133 plants/m²).
- Low-input management



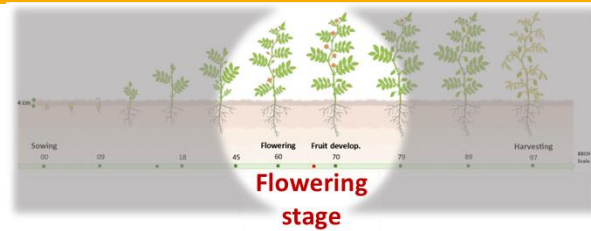
- **Sole crop biomass (control) > Intercrop biomass** but not always significant, depends on the CV
- **Pisa biomass > Udine biomass**
- Same trend between CVs in the 2 locations and in the 2 years

Wheat aboveground biomass both years



Factors	Chi_sq	Df	P-value (Chisq)
CV	20,3583	5	0,0010703 **
Year	11,6084	1	0,0006565 **
Place	22,1612	1	2,507e-06 ***
CV:Year	4,3358	5	0,5021477
CV:Place	4,5235	5	0,4767443
Year:Place	0,7831	1	0,376238
CV:Year:Place	4,3842	5	0,4955238

Results

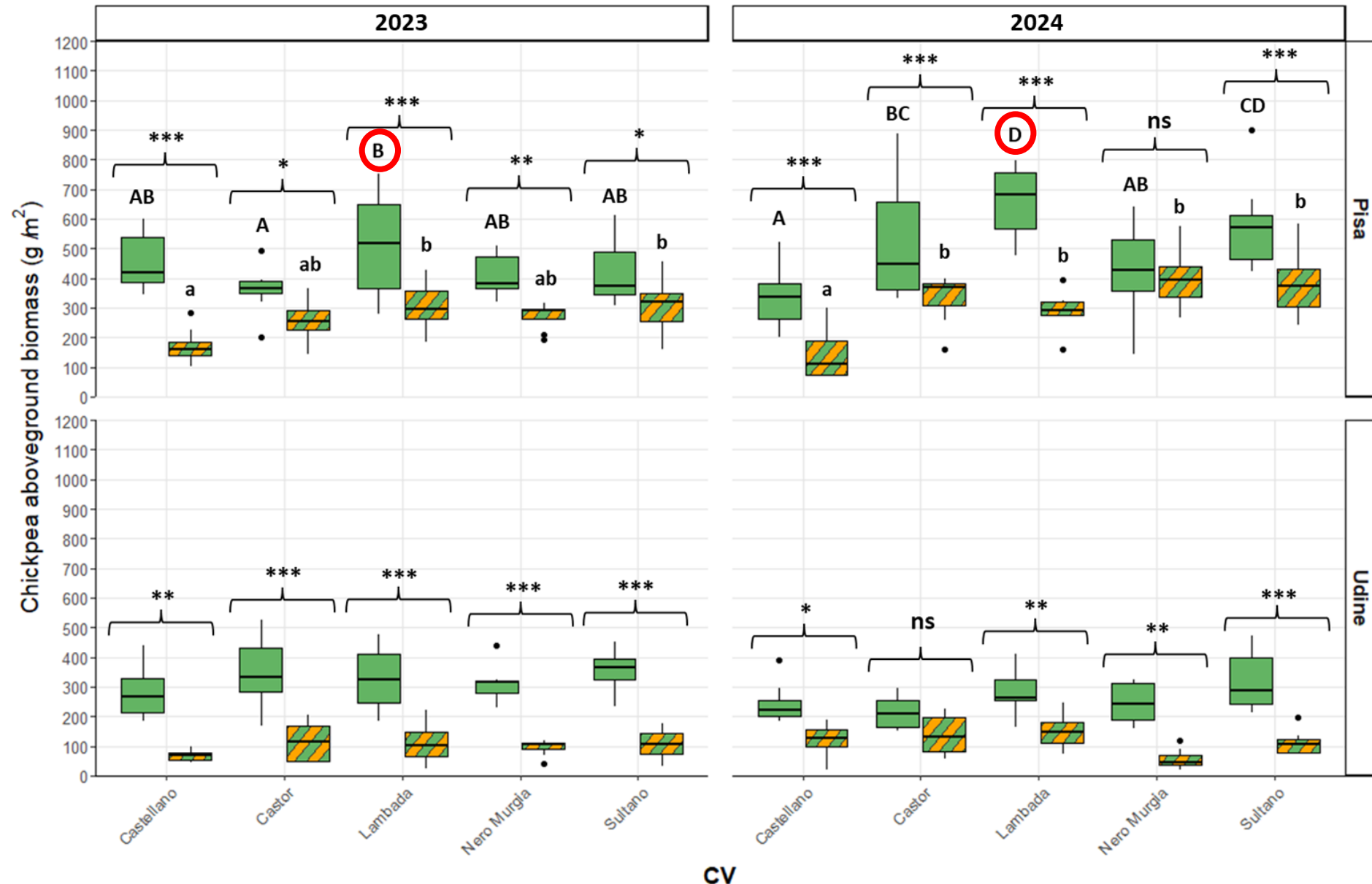


- Sole crop biomass > Intercrop biomass

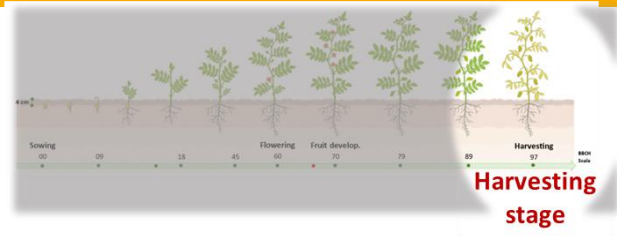
- Pisa biomass > Udine biomass

- In Pisa *Lambada* and *Sultano* had the highest biomass production while *Castellano* the lowest. In Udine no differences between CVs in the 2 years

Chickpea aboveground biomass both years

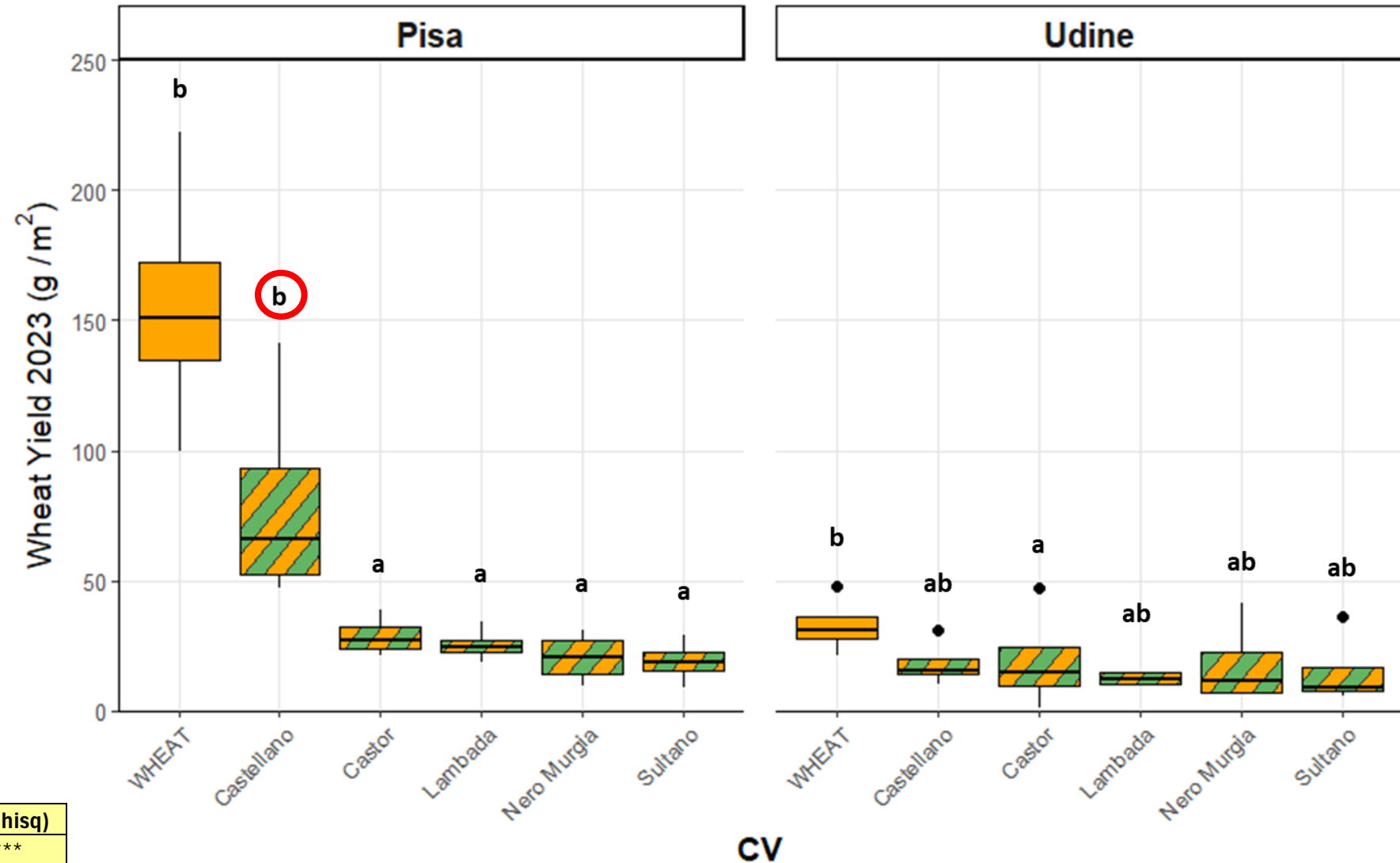


Factors	Chi_sq	Df	P-value (Chisq)
CV	13,9500	4	0.0074564 **
Place	13,7682	1	0.0002068 ***
Year	5,6524	1	0.0174320 *
Intercrop	26,3031	1	2.918e-07 ***
CV:Place	9,3162	4	0,0536643 .
CV:Year	22,9686	4	0.0001285 ***
Place:Year	0,4921	1	0,4830035
CV:Intercrop	10,2254	4	0.0367970 *
Place:Intercrop	0,7337	1	0,3916876
Year:Intercrop	0,2260	1	0,6345321
CV:Place:Year	12,4979	4	0.0140086 *
CV:Place:Intercrop	0,9342	4	0,919609
CV:Year:Intercrop	7,1469	4	0,1283262
Place:Year:Intercrop	0,7960	1	0,3722868
CV:Place:Year:Intercrop	3,7203	4	0,4451796



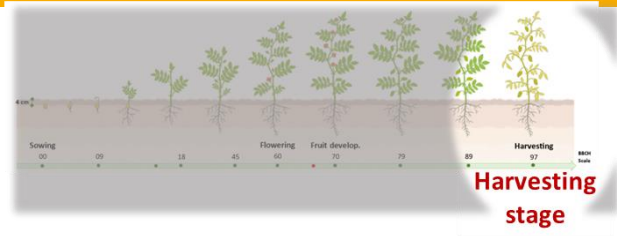
- Sole crop yield (control) > Intercrop yield but not always significant, especially in Udine
- Pisa yield slightly higher than Udine yield
- Same trend between CVs in the 2 locations except for *Castellano* in Pisa

Wheat yield 2023



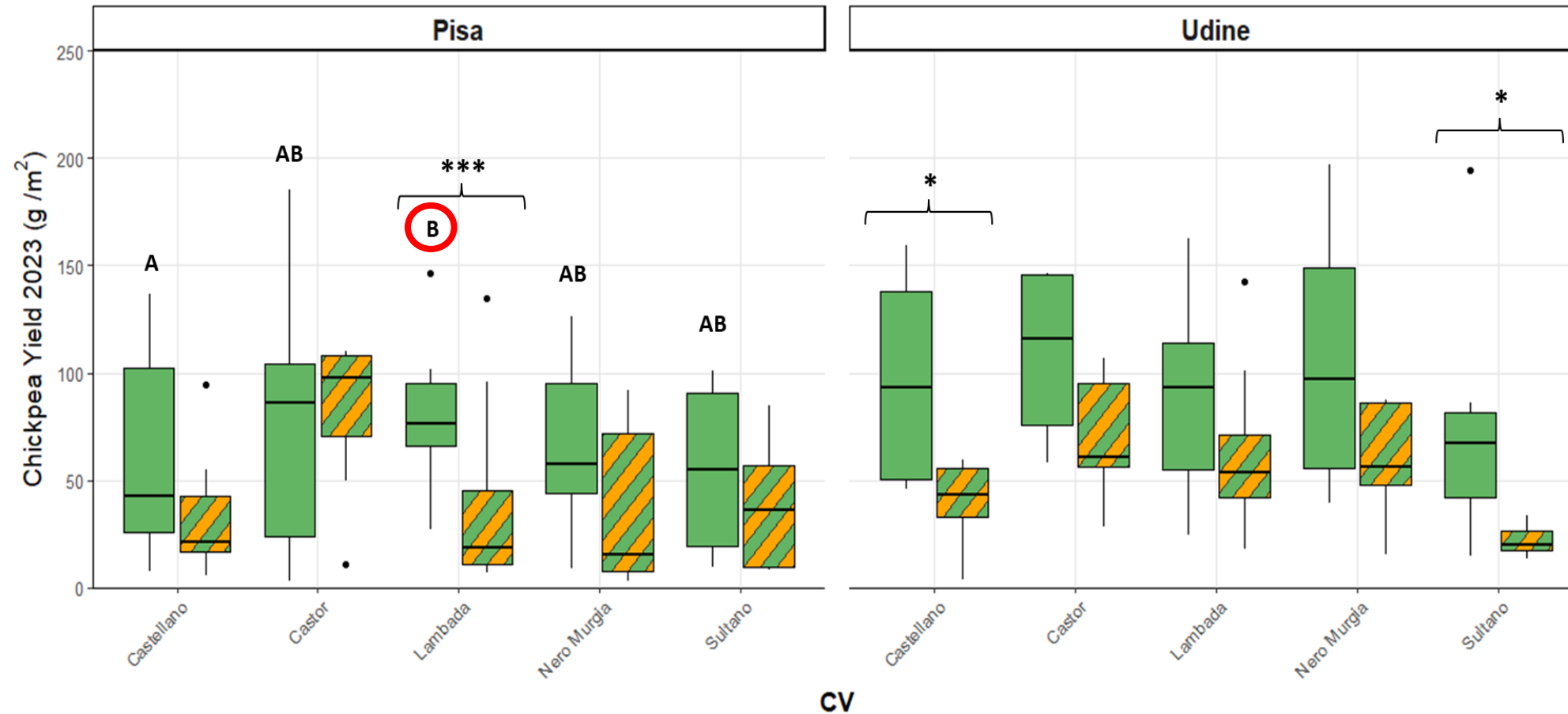
CV

Factors	Chi_sq	Df	P-value (Chisq)
CV	30,8310	5	1,012e-05 ***
Place	13,5150	1	0,0002367 ***
CV:Place	24,8650	5	0,0001480 ***



Factors	Chi_sq	Df	P-value (Chisq)
CV	11,8014	4	0,0188911 *
Intercrop	1,3900	1	0,2384058
Place	1,7822	1	0,1818743
CV: Intercrop	8,1238	4	0,0871485 .
CV: Place	4,7296	4	0,3161858
Intercrop: Place	0,6101	1	0,4347436
CV: Intercrop: Place	4,7230	4	0,3169129

Chickpea yield 2023



- Sole crop yield > Intercrop yield but no differences between sole and inter-cropping CV pairs and between locations
- In Pisa sole crop *Lambada* was the most productive and *Castellano* the least. In Udine no differences
- Weed problems and bad weather compromised production 2023

- ✓ **Chickpea and wheat aboveground biomass are higher in Pisa than in Udine.**
- ✓ **Chickpea aboveground biomass at flowering is higher when it is in sole crop than in intercrop. For wheat the difference is not always significant** but it depends on the chickpea CV. **Intercropping**, instead, **improved the weed control** compared to chickpea sole crop (mechanical hoeing applied; data not shown).
- ✓ **Chickpea yield is not significantly higher in sole crop than intercrop.** In Pisa, sole crop *Lambada* was the most productive and *Castellano* the least. Wheat yield is similar in sole crop and intercrop plots especially in Udine.

Data from the 2024 harvest are still being acquired and analysed and the experiment will continue in the coming years.





<https://legita.uniud.it/>



<https://linktr.ee/goagroecology>



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