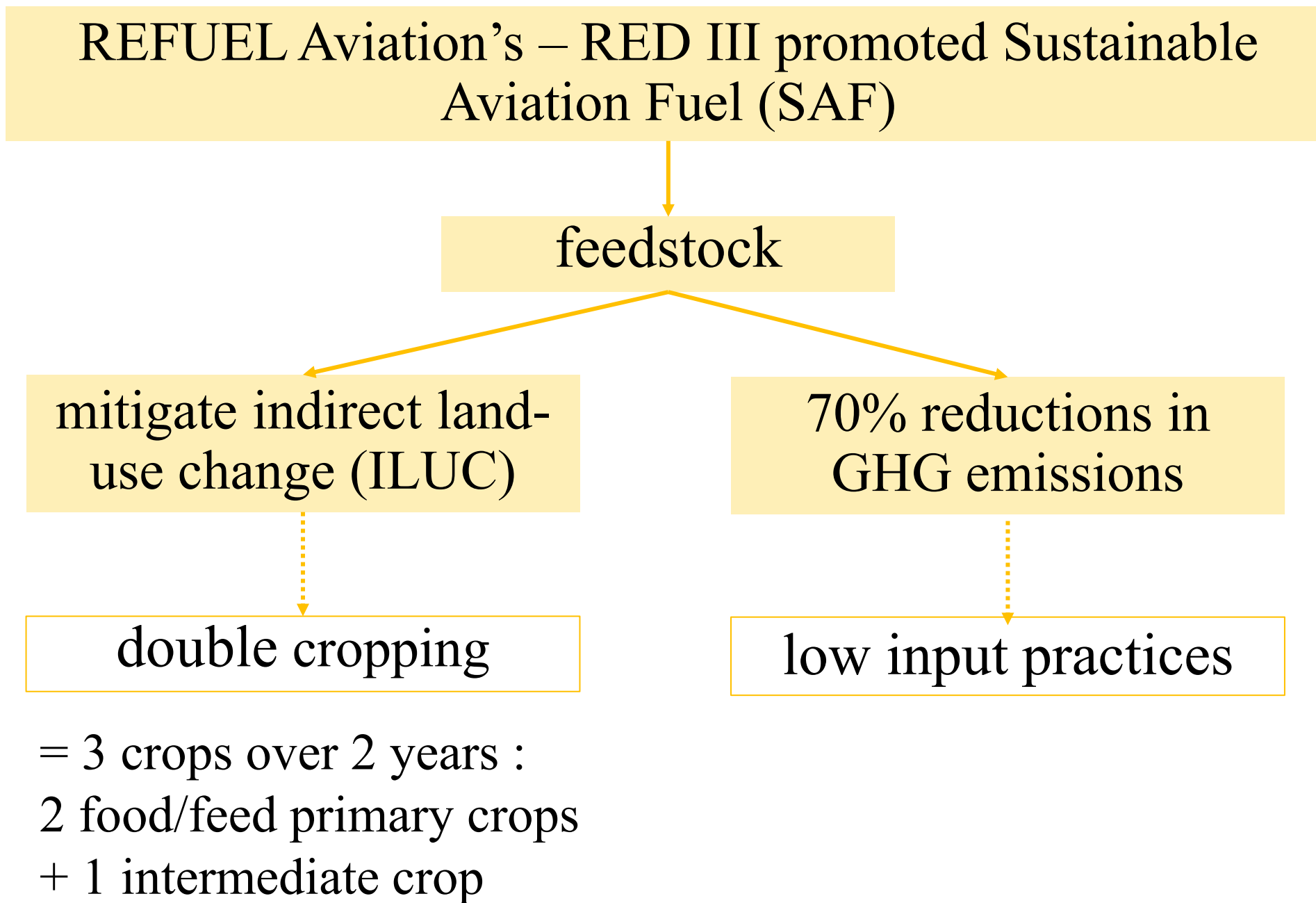


Introducing camelina in French cropping system as new oilseed crop to produce sustainable aviation fuel

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Outline



=> camelina crop

- short growing cycle,
- drought tolerance,
- low input requirements,
- genetic adaptability to summer and winter seeding

Study framework



- Objective: Provide regional recommendations on farm practices to introduce camelina in French cropping system in double cropping

→ 2 potential double crop succession :

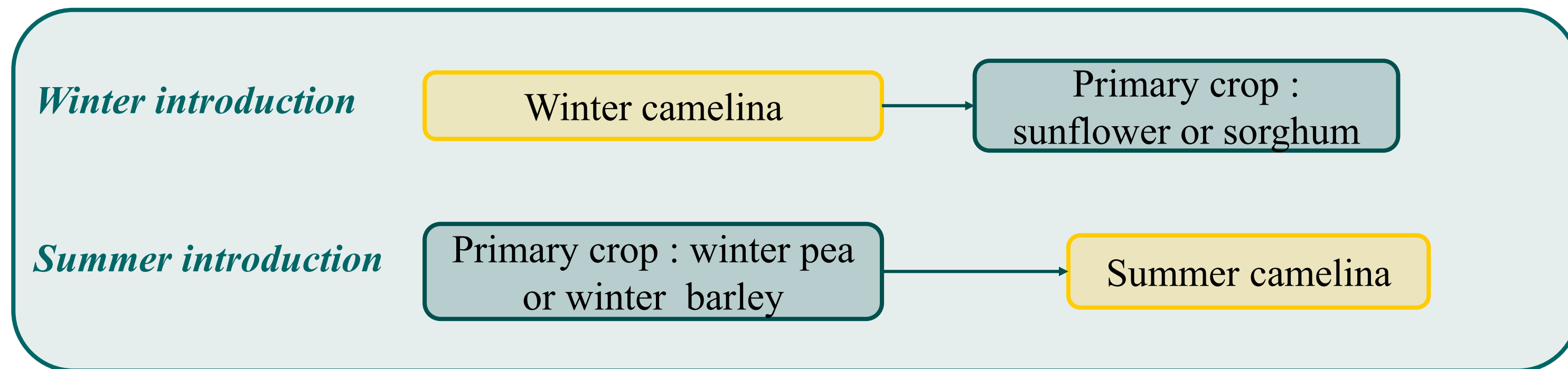
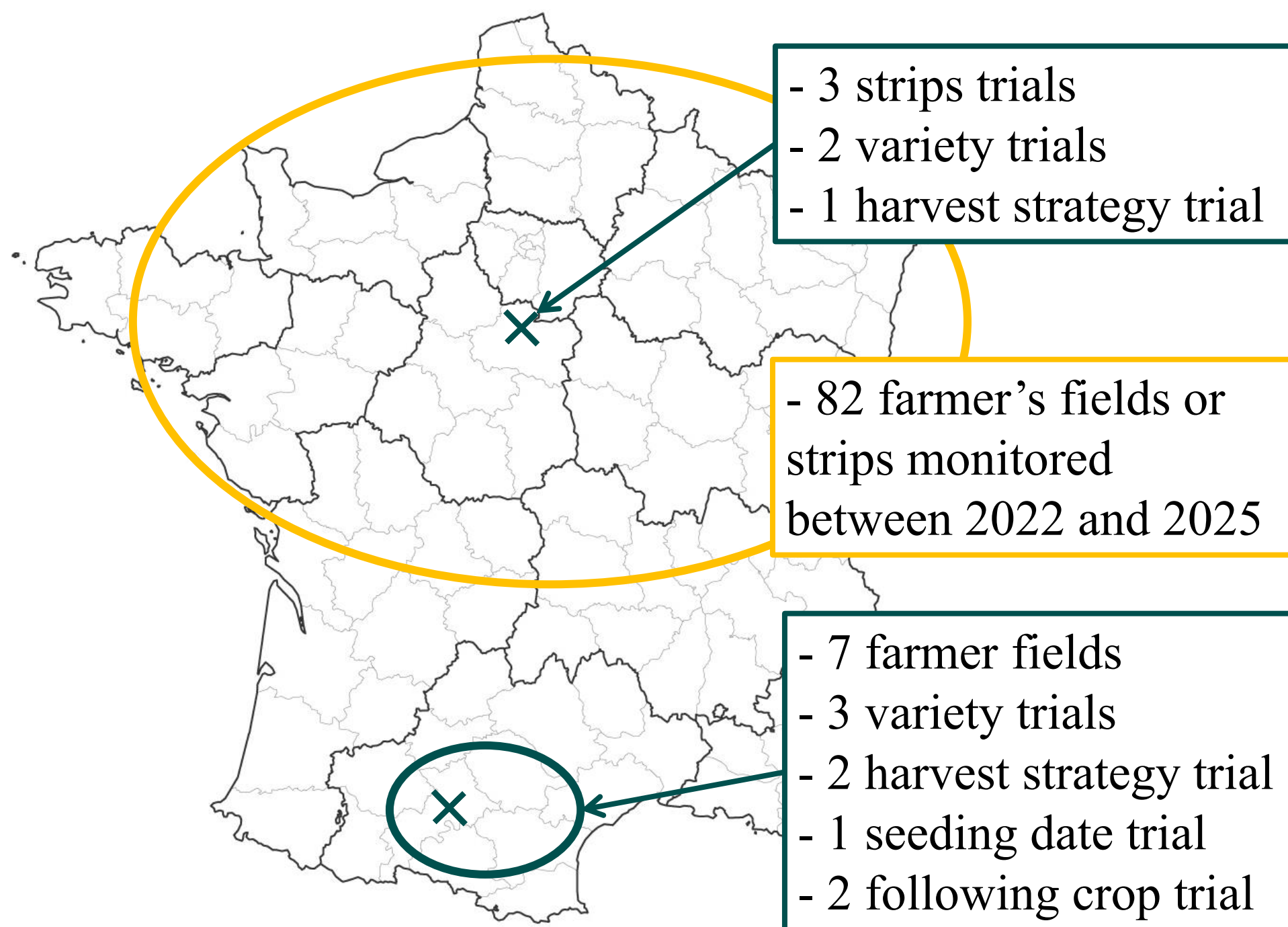


Figure 1. Crop successions tested in the study to introduce camelina crop

Experimental network



Location

- Farmer's fields (>0.5 ha)
- × Experimental design trials

Double cropping introduction

- Winter camelina
- Summer camelina

- Data collection :
 - Measurements : plant density, phenological stage, grain yield and, moisture content
 - Climatic data follow-up (growing degree days - GDD, rainfall...).
 - ANOVA analyses for each plot trial

Figure 2. Locations of farmer's field and trials established in France from 2023 to 2025

Double cropping with camelina as winter intermediate crop

→ *Time between the two crops is a main issue in double cropping*

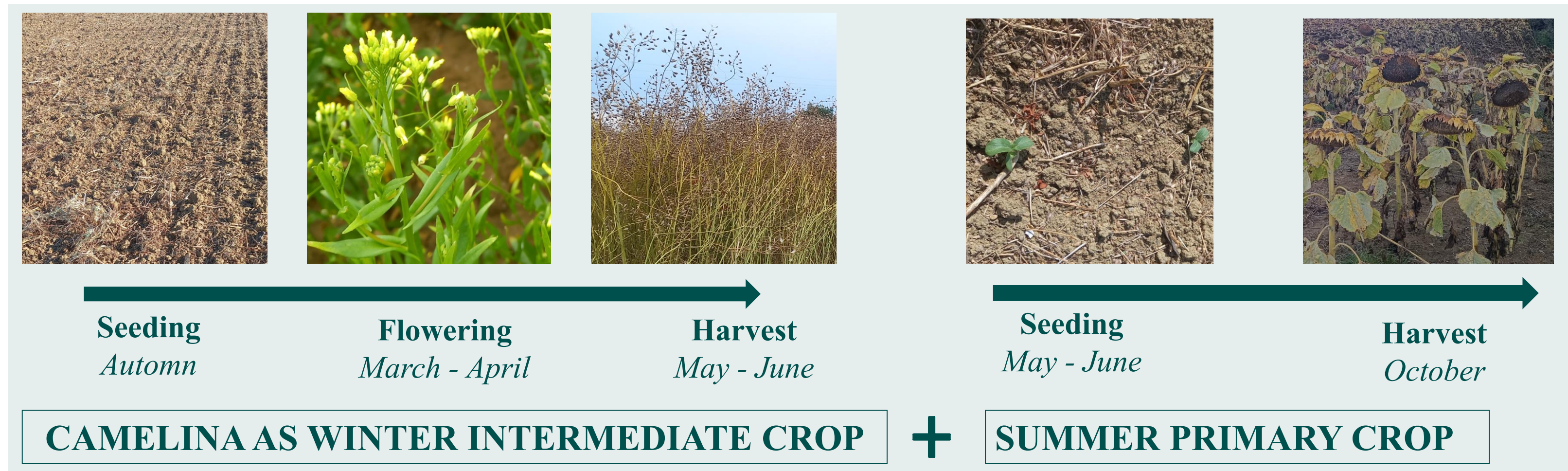


Figure 3. Timeline of the crop succession with camelina as winter intermediate crop

How to mitigate the impact on following primary crop ?

- The optimal seeding date
- Variety choice
- Harvest strategy
- The following primary crop

Winter camelina yield results

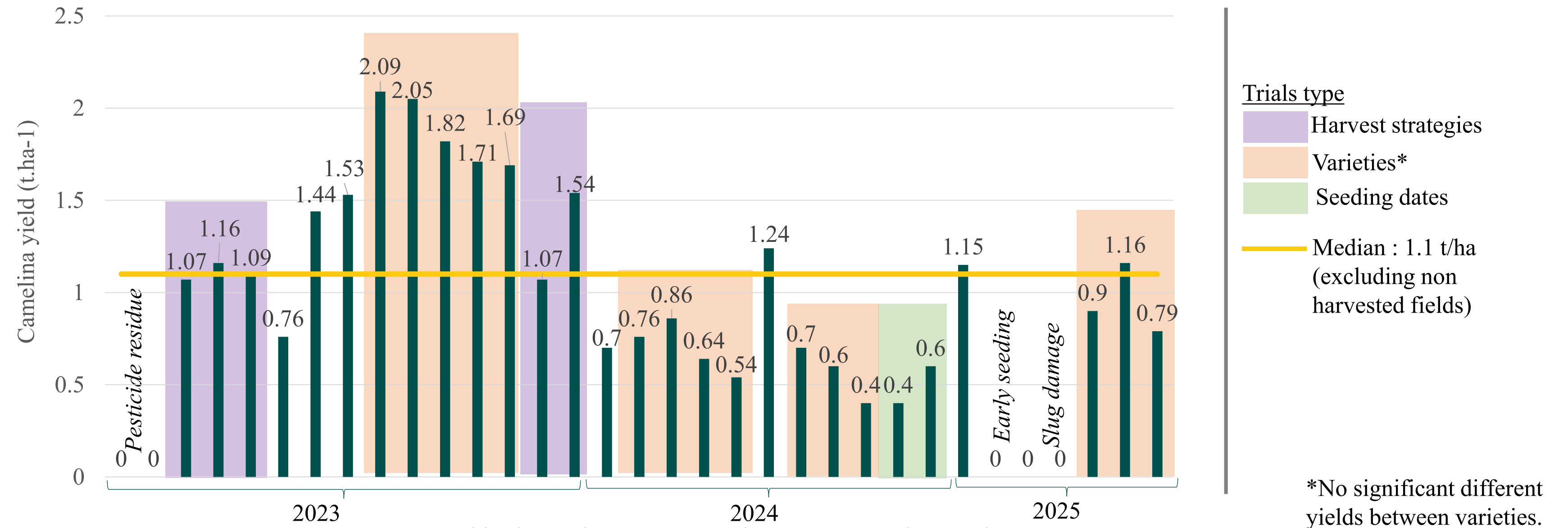


Figure 4. Yields obtained on winter camelina experimental network

With an adapted crop management, 1.5 t·ha⁻¹ can be reached with winter camelina.

→ The optimal seeding date

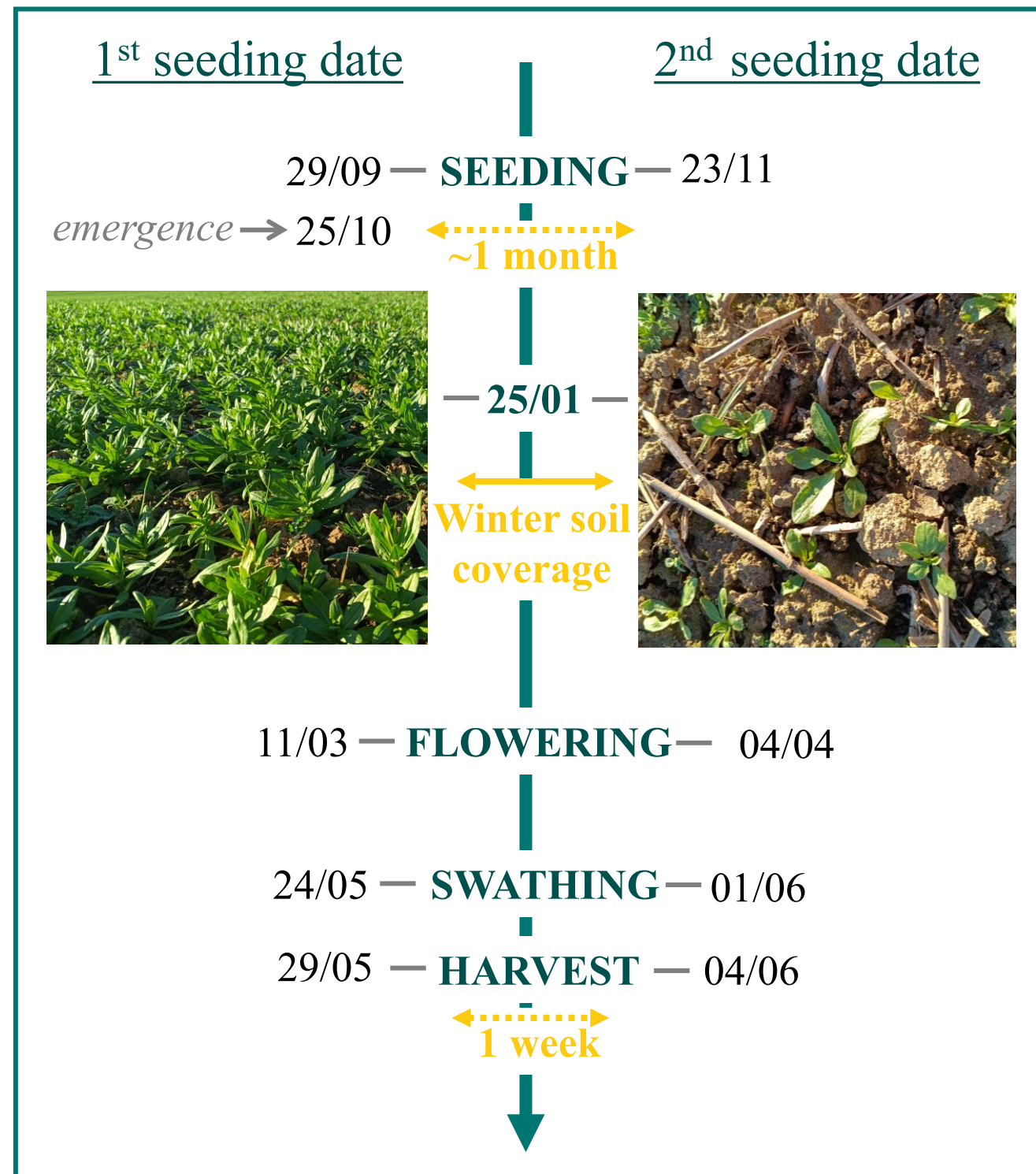


Figure 5. Seeding date trial – Southwestern 2024

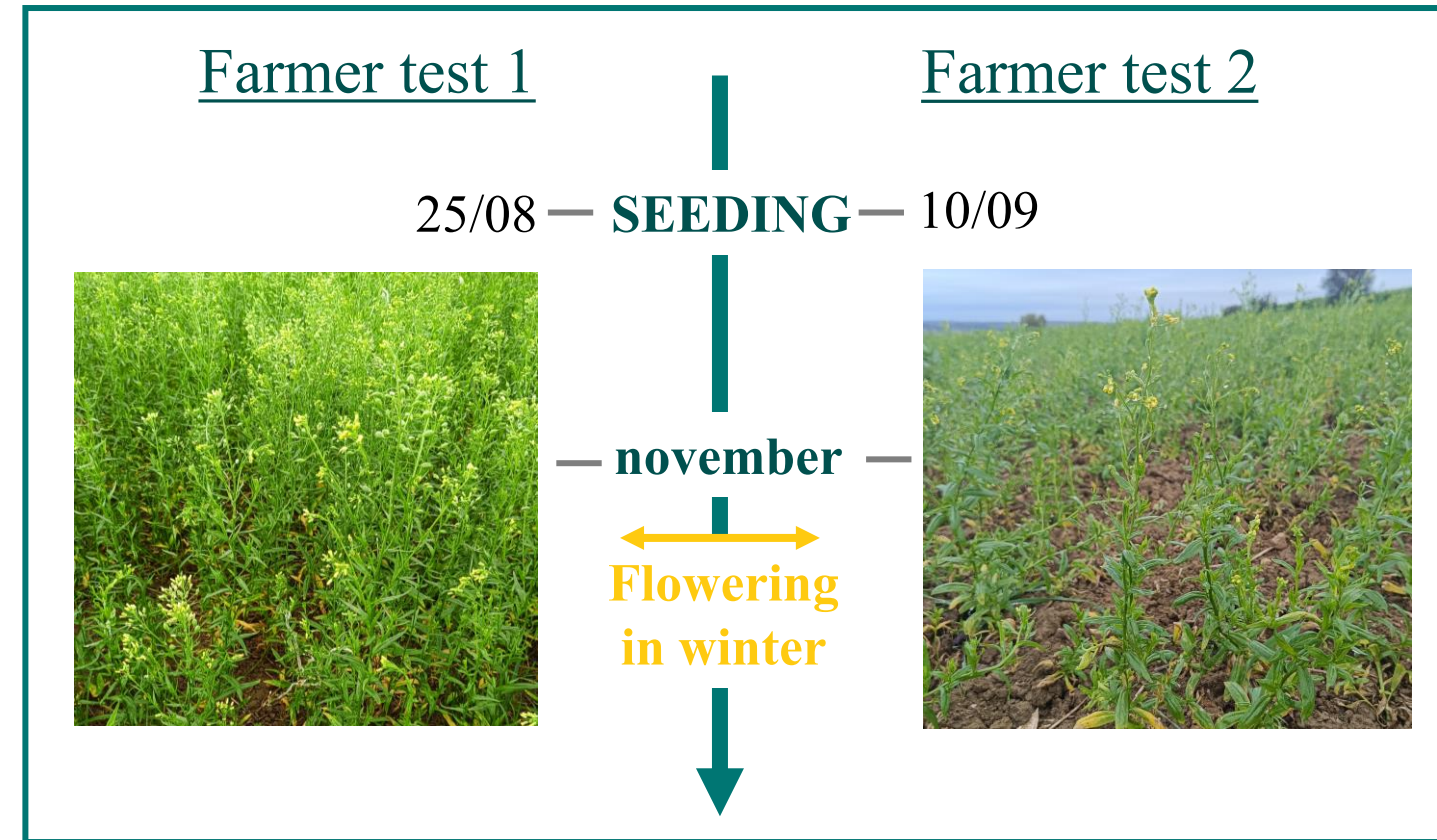


Figure 6. Farmer fields – Southwestern 2025

- /!\ Camelina is sensitive to frost at flowering.

- An early seeding date enables an earlier harvest. This gain of days can be decisive for the establishment of a following primary crop.
- Further research are needed regarding soil preparation and seeding techniques.

=> Optimal seeding date from the 1st to 20th October

→ Fasten the harvest with swathing

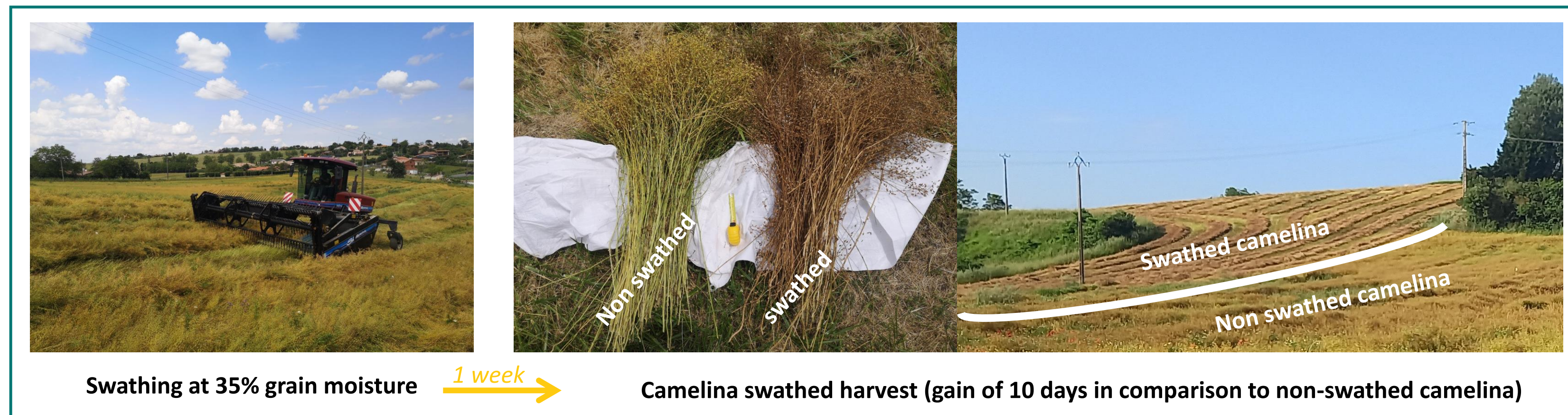


Figure 7. Harvest strategies trials – Southwestern 2023

- Swathing to fasten harvest:

- No grain losses evidence (*Pari et al. 2024*)
- Swathing can bring harvest forward by about a week or more, helping preserve the seeding date of the following crop.
- Few constraints: period of 5 days without rain for natural dessication

- Other opportunity:

- Dessiccant with pelargonic acid
- (Sessa et al. 2023) = harvestable after 3 days
- No evidence in our trial 2025 (probably due to weather condition application)

→ The following primary crop

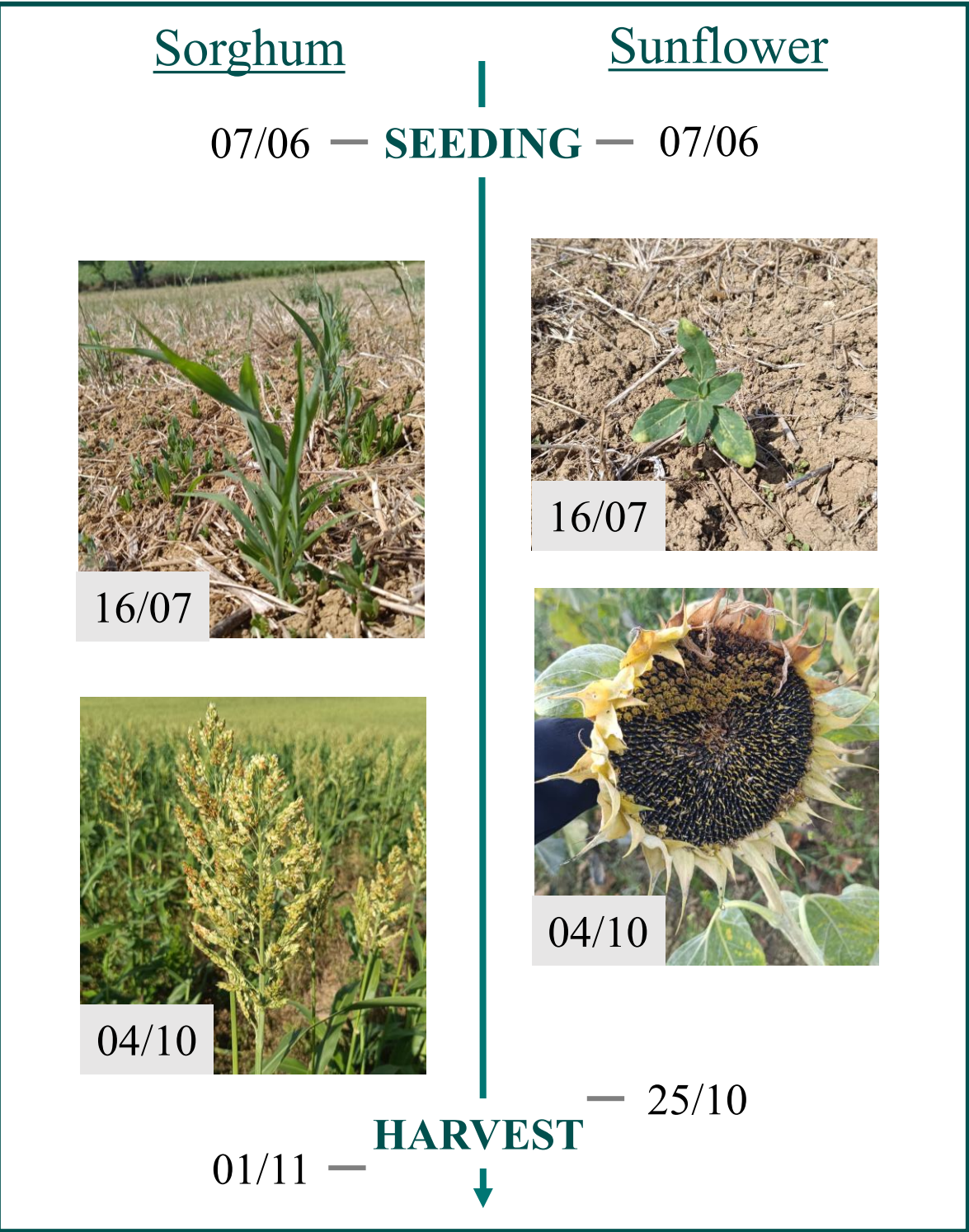


Table 1. Primary crop trial – Southwestern 2024

Trial	Primary food/feed crop	Seeding date	Yield (t/ha)
Farmer - southwestern, 2024	Sunflower after camelina	30 th May 2024	1.7
	Sunflower reference	April 2024	2.4
Southwestern, 2024	Sunflower after camelina	7 th June 2024	0.4
	Sorghum after camelina	7 th June 2024	1.5
Southwestern, 2025	Sunflower after camelina	11 th June 2025	x
	Sunflower reference	11 th April 2025	1.8
	Sorghum after camelina	11 th June 2025	2.9
	Sorghum reference	26 th May 2025	5.1

} -30%

} -43%

Impacts on the subsequent crop are variable and strongly dependent on timing : harvest advancement of camelina and **early seeding of main crop**. During study, winter camelina was in process to be harvested earlier, therefore, the reductions we observed in **one site-year should be interpreted cautiously and not generalized**.

Figure 8. Primary crop trial – Southwestern 2024

Double cropping with camelina as summer intermediate crop

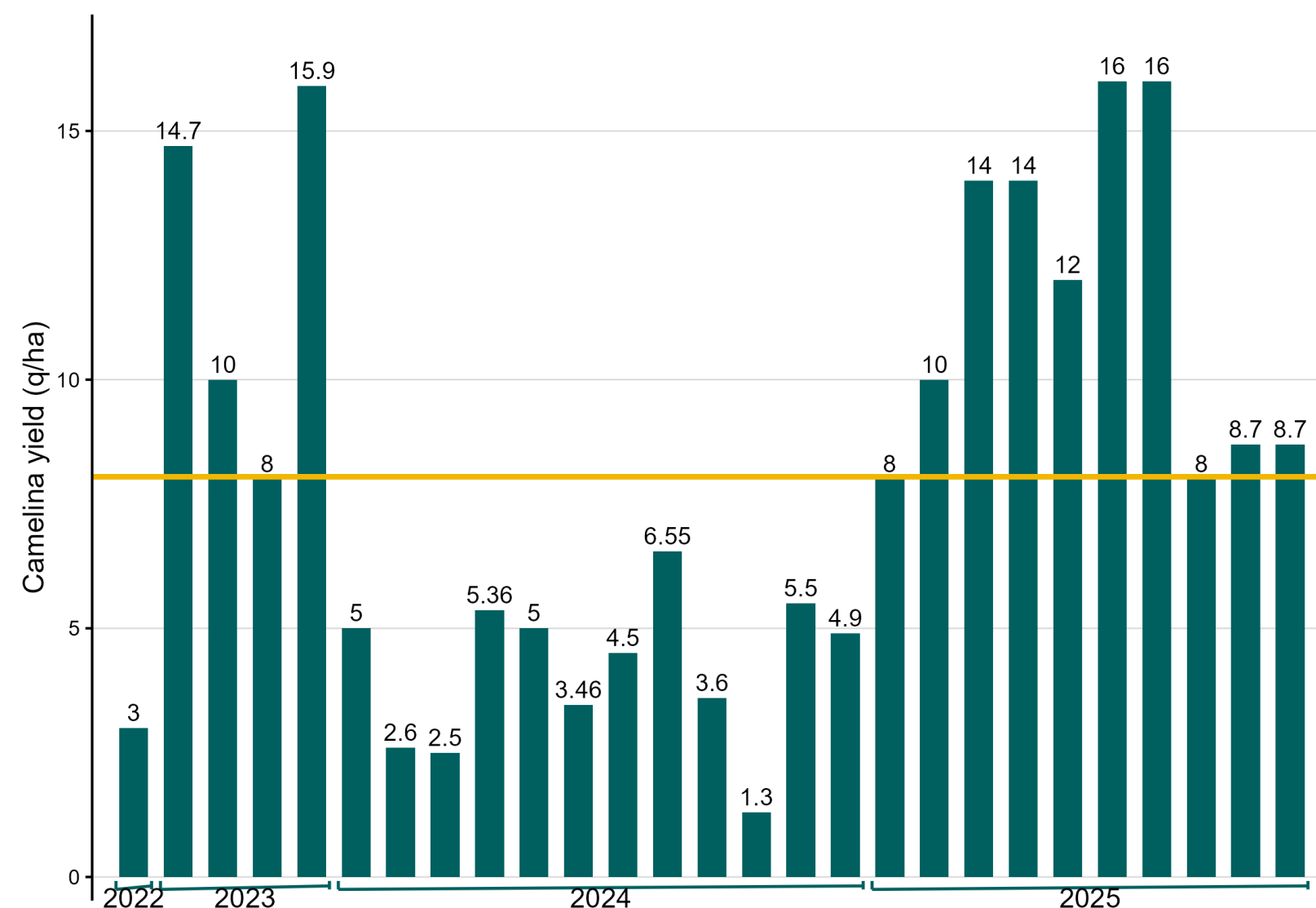


Figure 9. Timeline of the crop succession with camelina as summer intermediate crop

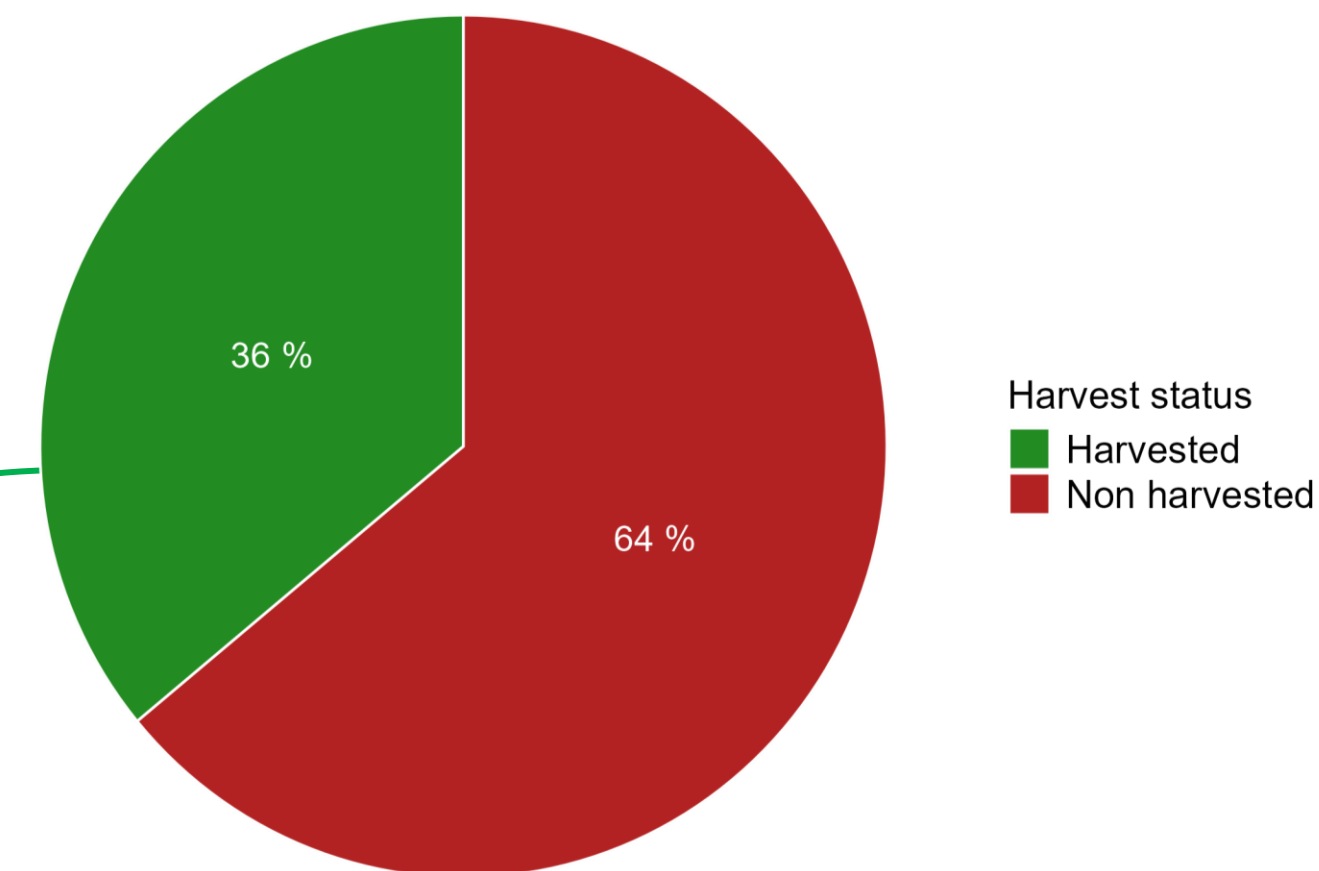
Camelina seeding as soon as possible to ensure a quick emergence

Camelina harvest as soon as possible for the implantation of the following crop

Summer camelina yields



0.8 t/ha



- Lack of rain at seeding,
- Bad weather conditions at harvest
- Grain moisture content

Figure 10. Yields obtained on summer camelina experimental network

On average, summer camelina yield reached around 0.8t/ha for the harvested plots, with 64% failure risk due to unfavorable climatic conditions at seeding and at harvesting, and lack of knowledge for farmers.

The optimal seeding and harvest date

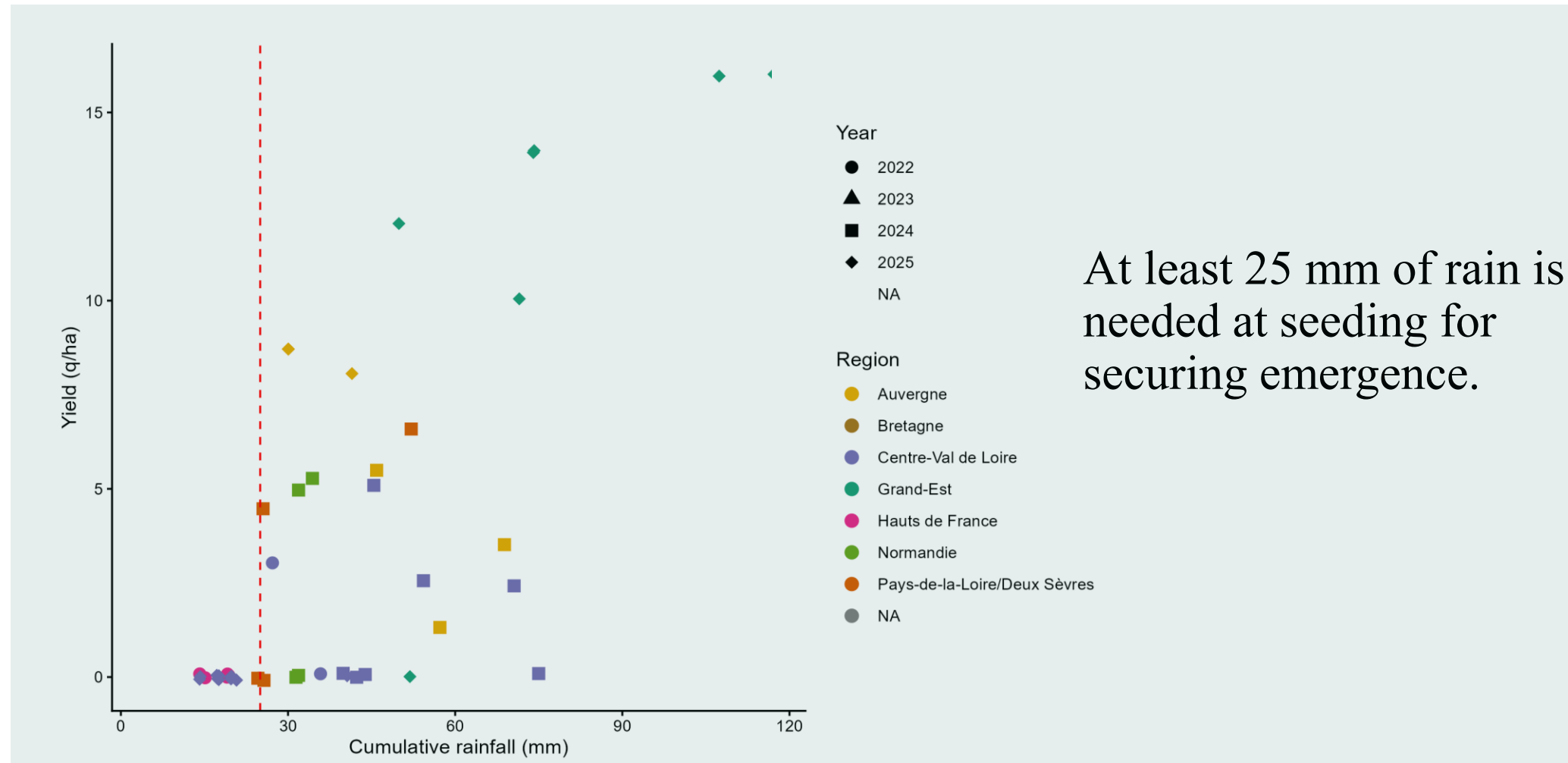


Figure 11. Yield according to cumulative rainfall from 5 before and 20 days after seeding

For summer intermediate crop, camelina must be sown as early as possible to benefit from summer rainfalls and complete its cycle before October.

Swathing is an effective practice to gain a few days before harvest in cases of late maturity in October

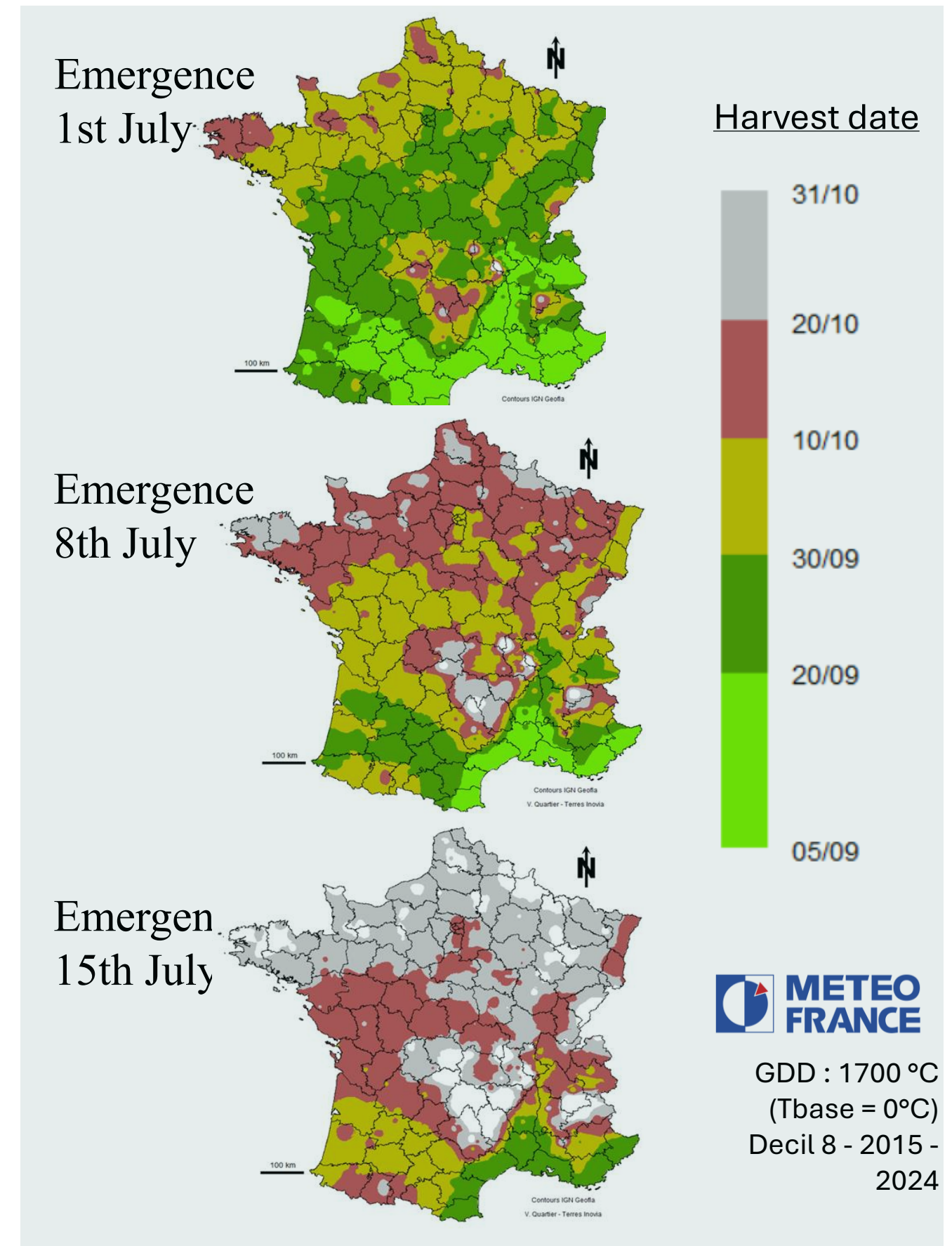


Figure 12. Harvest dates modelled according to emcamelina ergence

Profitability example : direct margin

→ Direct marging (€/ha) : yield x selling prices – input costs – mechanization cost

Based on references from 2025-2026

Winter camelina

Summer camelina

Table 2. Direct margin of crop succession camelina + sunflower (€/ha)

		Sunflower yield (t/ha)						
		0.5	1	1.5	2	2.5	3	3.5
Camelina yield (t/ha)	0.5	-703	-453	-203	47	297	547	797
	0.75	-553	-303	-53	197	447	697	947
	1	-403	-153	97	347	597	847	1097
	1.25	-253	-3	247	497	747	997	1247
	1.5	-103	147	397	647	897	1147	1397
	1.75	47	297	547	797	1047	1297	1547
	2	197	447	697	947	1197	1447	1697
	2.25	347	597	847	1097	1347	1597	1847
	2.5	497	747	997	1247	1497	1747	1997

Direct margin

Negative

Positive

Outperforming
baseline sunflower (2.3
t/ha)

Table 3. Direct margin* (€/ha) of different crop successions including summer camelina (€/ha)

		Crop succession scenario			
		No. 1	No. 2	No. 3	No. 4
Camelina yield (t/ha)	0.4	-45	-95	-83	-128
	0.6	75	25	37	-8
	0.8	195	145	157	112
	1	315	265	277	232
	1.2	435	385	397	352
	1.4	555	505	517	472
	1.6	675	625	637	592
	1.8	795	745	757	712

Direct margin

Negative

Positive

Scenario

1 : pea, direct seeding

2 : barley, direct seeding

3 : pea, superficial tillage

4 : barley, superficial tillage

Based on economic calculations, camelina must yield at least 1 t·ha⁻¹ and sunflower at least 1.5 t·ha⁻¹ to outperform a baseline sunflower.

A yield of 0.6 t/ha enable a positive direct margin in most scenarios. Direct seeding and pea residual nitrogen reduces camelina costs.

Camelina practices recommendations

General recommendations

SEEDING

Seeding density :
6 to 8 kg/ha

! herbicide residues
group 2 and 14

WEEDS

- dicotyledons weeds management complicated (lack of phytosanitary product)
- gramineous weeds management possible with few phytosanitary product

PESTS

- low sensitiveness to flea and pollen beetle
- mildew symptoms possible at the end of the cycle without impact on yield
- sensitive to hernia cruciferous

HARVEST

- Harvest at **8-9 % moisture grain** (maximum 13-15%) = yellow to brown grain
- Yield potential : **1 t/ha to 1.5 t/ha**
- Swathing recommended (to manage weeds pressure and to fasten harvest)

PRECEDING
CROP

SEEDING

FLOWERING

HARVEST

FOLLOWING
CROP

Specific recommendations

TILLAGE for summer camelina

- Direct seeding strongly recommended with tooth tool (avoid disk tool)
- Superficial tillage at maximum 2-3 cm depth
- In case of seeding after barley : straw management mandatory

SEEDING

- winter camelina : from 1st to 20th October in row or broadcasting at 2 cm depth maximum
- summer camelina : avoid superficial seeding, direct seeding at 2 cm depth and 1-2 cm depth after tillage

FERTILIZATION

- winter camelina : 40 to 60 kgN/ha at seeding and/or rosette
- summer camelina : 40 kgN/ha after barley and 10 kgN/ha after pea at seeding

IRRIGATION for summer camelina

- 10 to 20 mm at seeding (strongly recommended)
- optional :
20 to 25 mm at rosette stage
25 to 35 mm at flowering

Conclusion

Camelina could be developed with higher technical support both for **winter double cropping systems in Southwestern France** and **summer double cropping in Center, eastern and western France**.

For both crop sequences, **timing** is a crucial key point :

- **Early seeding** (before 10 July) is essential to ensure successful establishment of camelina as a summer intermediate crop, maximizing the opportunity to benefit from summer rainfall and enabling earlier harvest.

- When camelina is implemented as a winter intermediate crop, optimized seeding dates and **earlier harvest** are crucial to allow timely seeding of the following primary crop.

For both cropping sequences, **further research is needed** on soil preparation and seeding techniques, as well as on the management of the following crop in the case of winter camelina.

Thank you for your attention

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