What is the potential of cover crops and what do farmers say?

Lionel Alletto, Sophie Ducos-Boue, Noémie Gaudio, Guillaume Hustet-Caou, Jay Ram Lamichhane, Damien Marchand, Célia Seassau

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The Soil CARbon Farming network
SCARF

Some definitions

Service plants: species planted before, during or after a cash crop, intended to provide one or more ecosystem services to the following crop or crops in the rotation

Multi-Services Cover Crops **(MSCC) : a key-lever to store C in various cropping systems** (Pellerin et al., 2020)

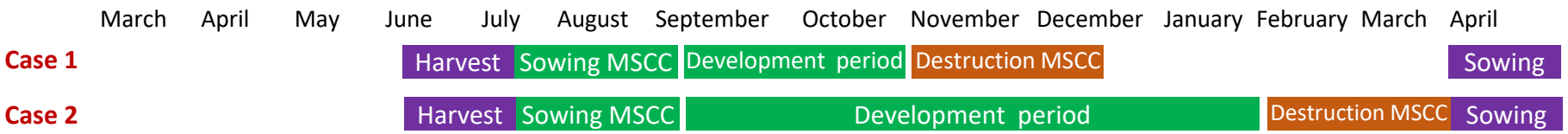
Fallow period: period between two cash crops

► **from 1 week to 9 months…**

A wide range of sowing and destruction periods of MSCC

Depending on: **cropping system, main goals, soil and climate conditions, …**

some examples of insertion of MSCC in cropping systems



Case 1: on clay soils in conventionnaly-tilled cropping systems

ex. destruction of bristle oat in November

Case 2: on loamy soils in cropping systems with reduce/no tillage

ex. direct sowing of maize within fababean

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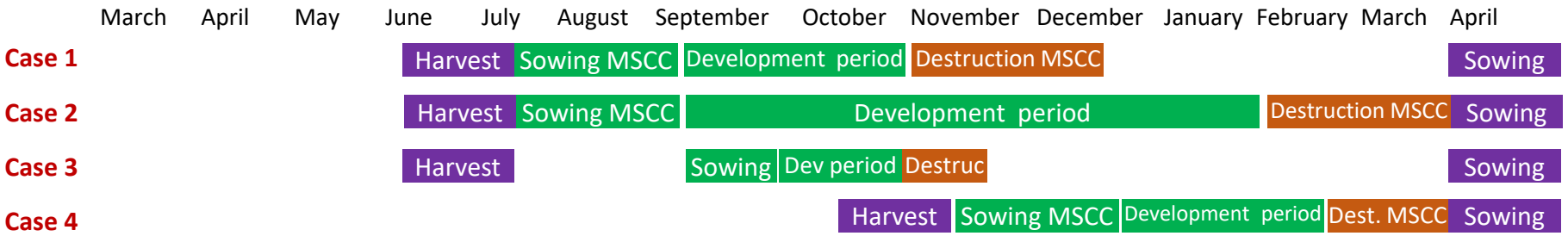

Case 3: sowing of the cover crop at the end of the summer to avoid the lack of water (but not taking advantage of the most intense period for the photosynthetic activity...)

ex. white mustard sown at the end of August

Case 4: sowing after a spring crop harvested in autumn: the choice of adapted species and varieties is quite reduced...

ex. fababean between two maize

nd what do farmers say?

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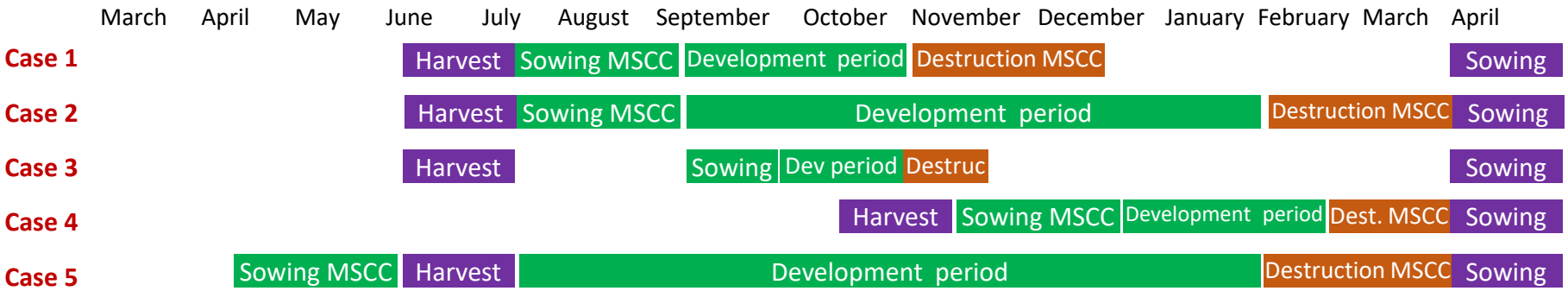

Case 5: implantation of the cover inside the cash crop at the end of its cycle

ex. clover sown within a soft wheat

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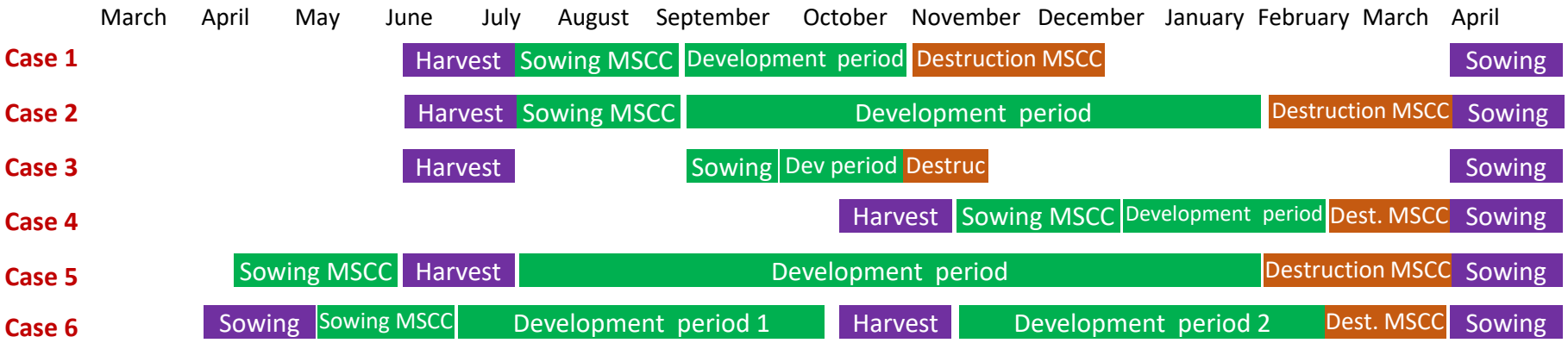

Case 6: early undersown cover crop in a cash crop

ex. Crimson clover undersown in maize at the 6-8 leaf stage

A wide range of sowing and destruction periods of MSCC

Depending on: **cropping system, main goals, soil and climate conditions, …**

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Case 7

Harvest | MSCC 1 | MSCC 2 | Sowing

Case 7: relay cropping of cover crops

ex. forage sorghum sown after harvesting a cereal and then sowing a faba bean + pea in the forage sorghum fully restored to the plot

Function and ecosystem service bundle provided by MSCC

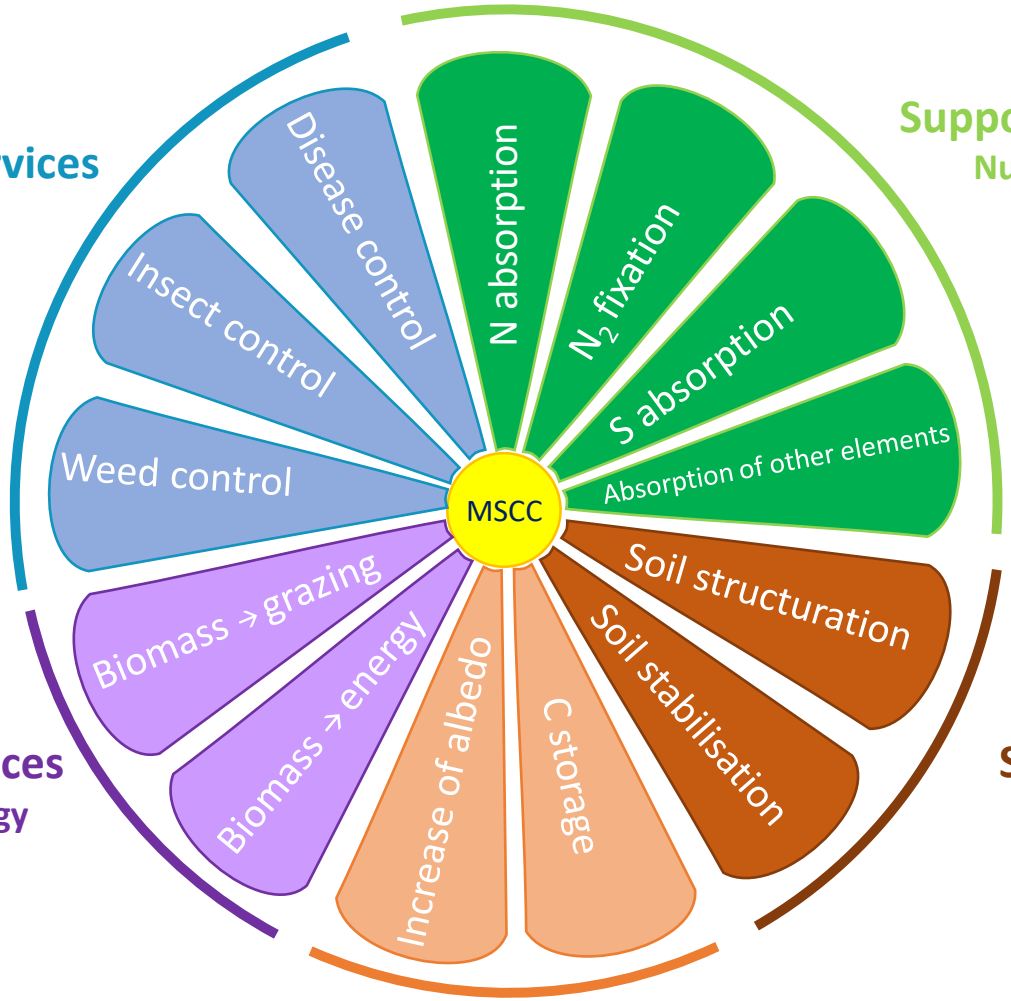


Illustration of the variability of C content and quantity in cover crops

During the SCARF Project :

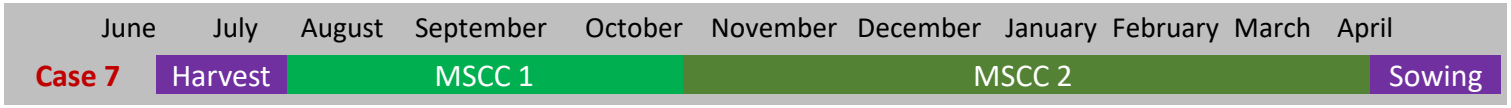
- **Database** gathering data from the various experiments conducted by INRAE UMR AGIR since 2004 :

≈ **2 700 of MSCC treatments**

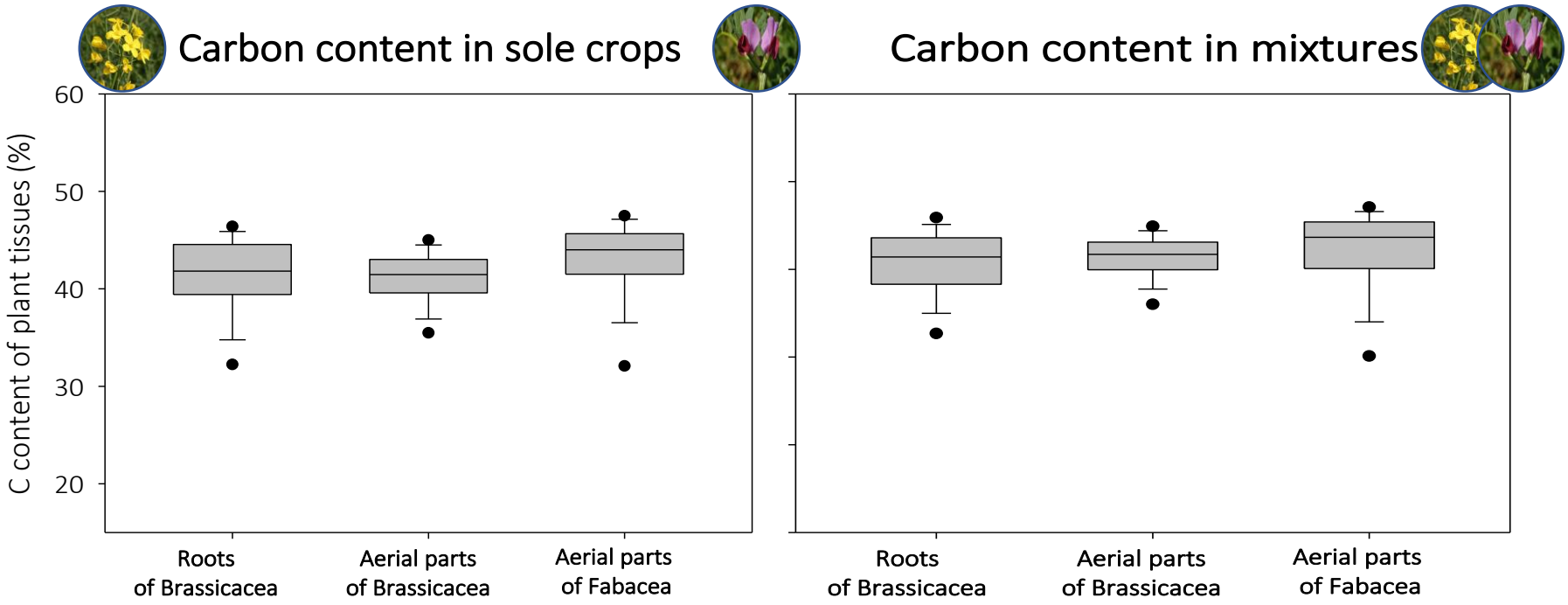
Example 1 : C content in aerial and root tissues of different species of Brassicacea and Fabacea (n = 1050)

Example 2 : C content in aerial tissues of relay cover crops (sorghum → fababean)

(n = 12 : additional data to come from various ongoing projects)

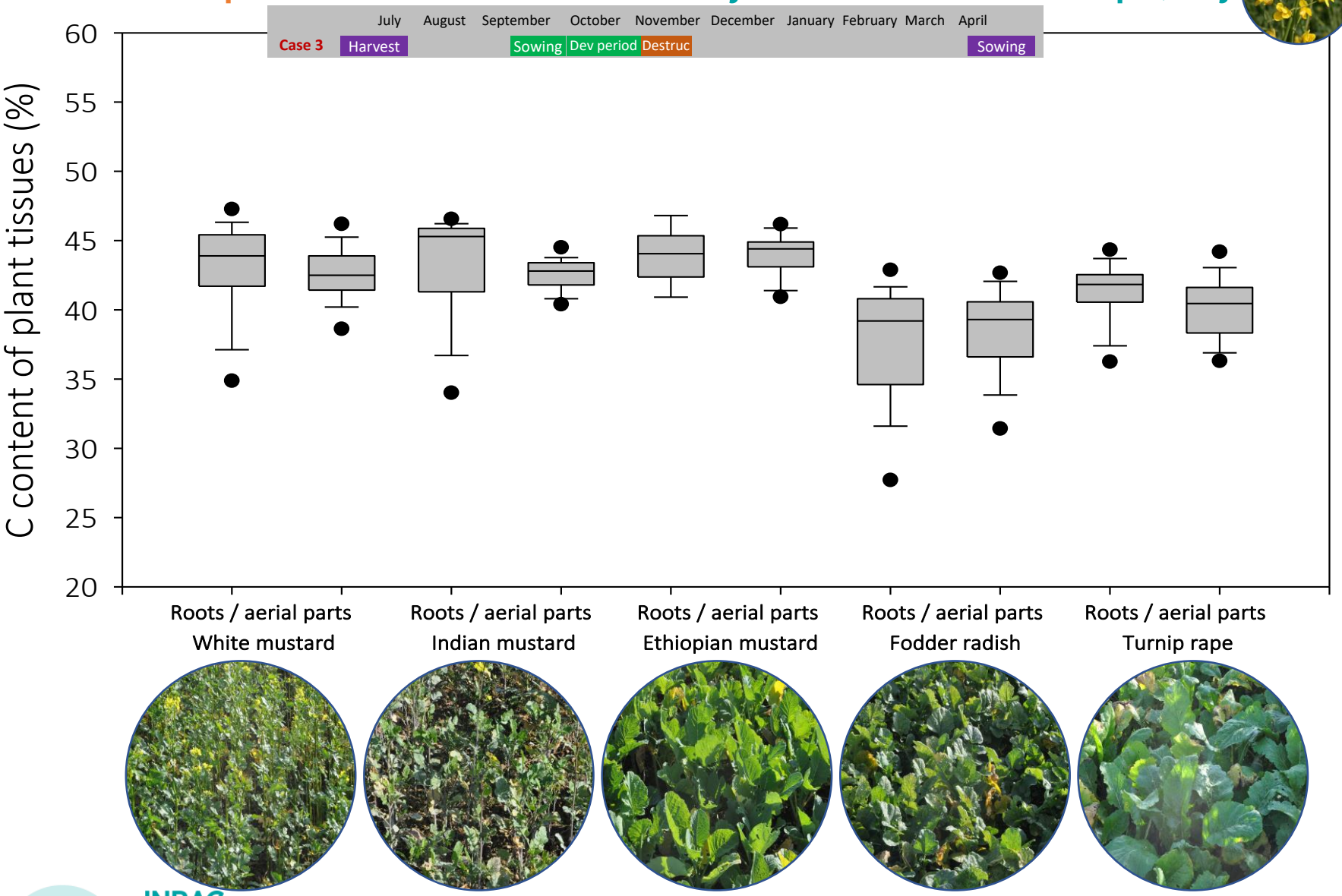


Example 1: Illustration of the variability of C content and quantity in cover crops

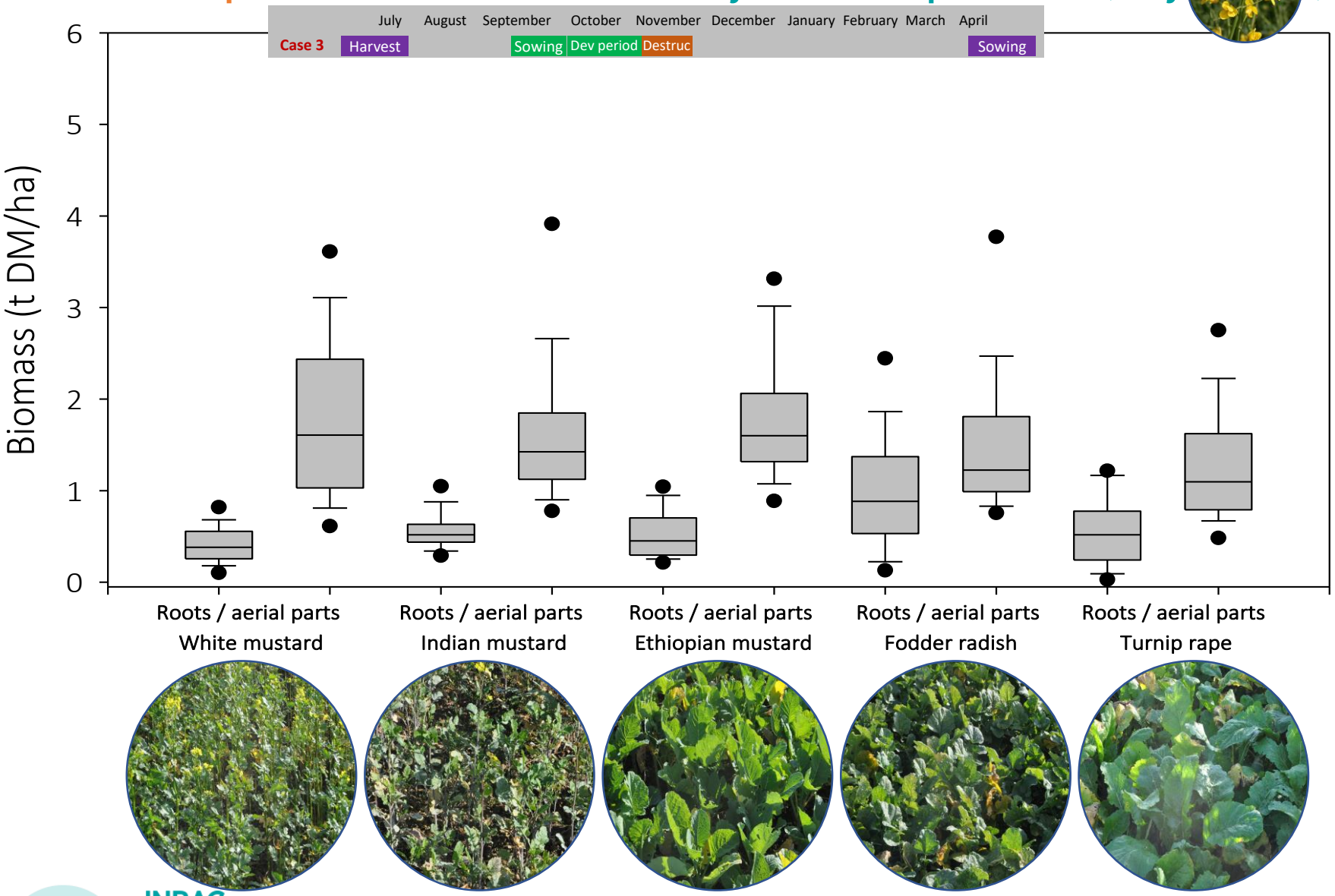


Mean (±SE)	41.2 ± 4.5	41.0 ± 3.4	41.8 ± 4.7	40.6 ± 4.3	41.2 ± 3.0	42.0 ± 5.1
Median	41.8	41.5	44.0	41.4	41.7	43.6

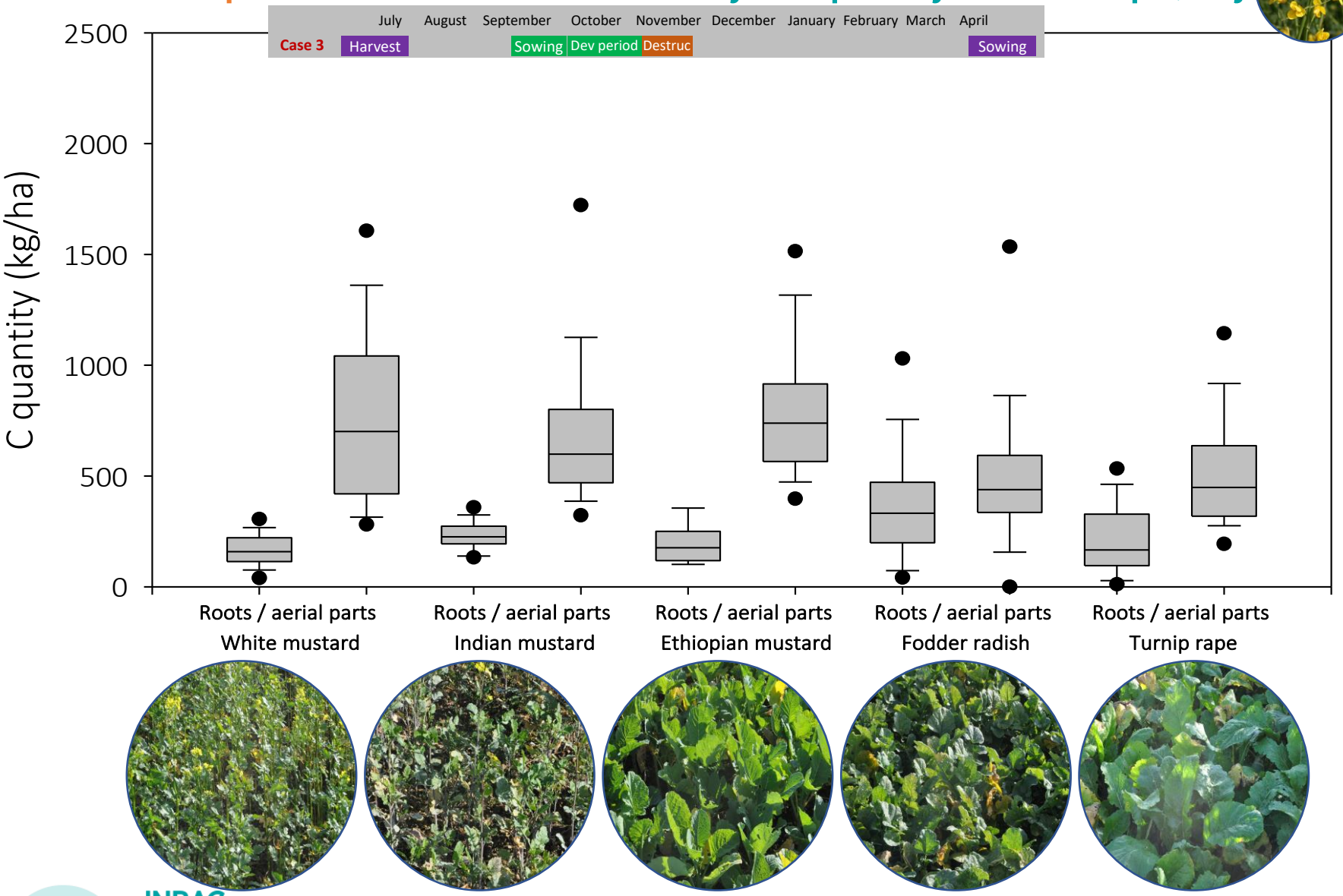
Example 1: Illustration of the variability of C content in cover crops (only)



Example 1: Illustration of the variability of cover crops biomass (only)



Example 1: Illustration of the variability of C quantity in cover crops (only)



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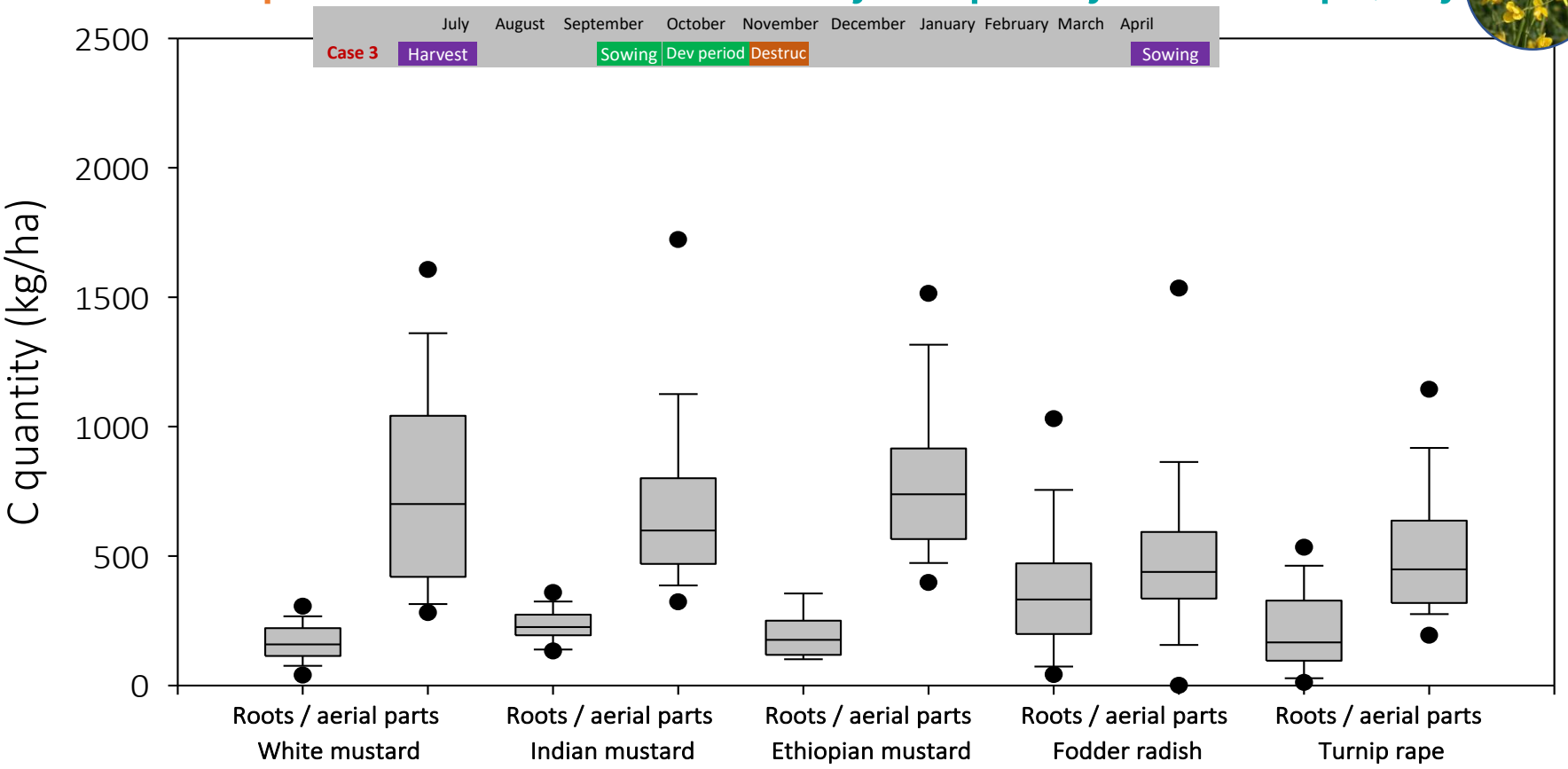
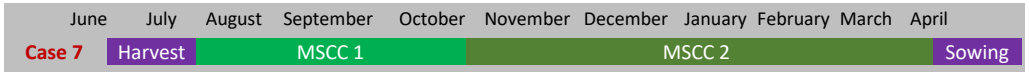
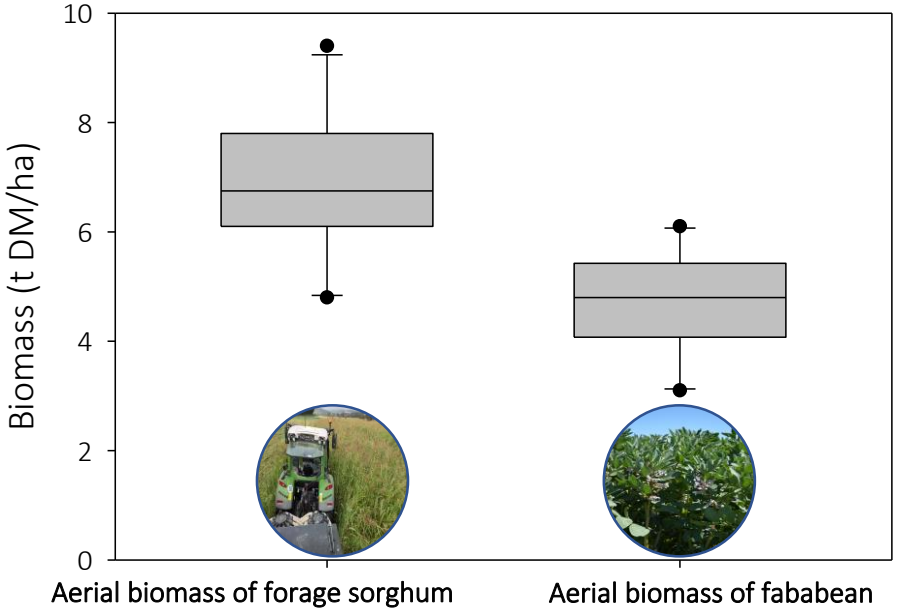
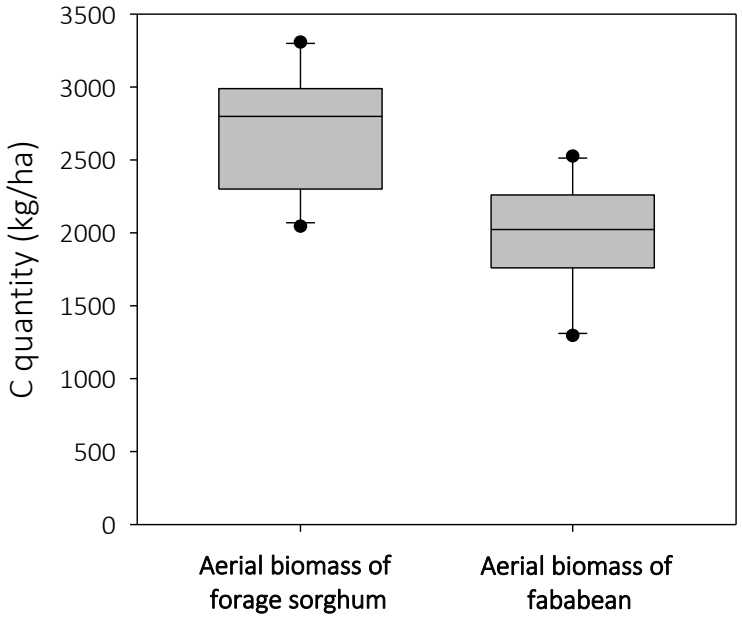


- For a short cycle length (2 months), **high variability in the quantities of C in biomass** for pure cover crops (from 150 to 3 100 kg C/ha)

Example 2: C quantity in relay cover crops







- For a long cycle length (9 months), **relay of cover crops biomass** allows to produce an important quantity of C / ha (> 4000 kg C/ha)

- To optimize the emergence and the production of sorghum during the summer period, an irrigation (25-30 mm) may sometimes be necessary

Conclusion

- **Cover crops** are **an efficient lever** (one of the only ones) to store C in field crops (without livestock)

- There is a **wide variety of strategies** to effectively introduce cover crops at different times in cropping systems

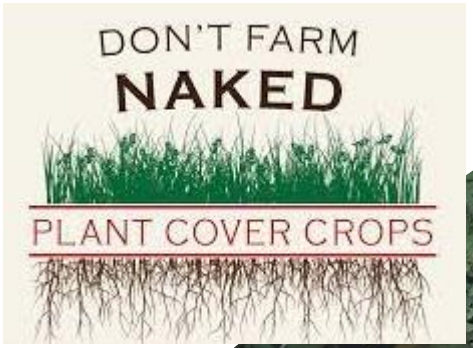
  → *A multi-criteria approach is necessary to reason their insertion*

- The amount of carbon captured by cover crops depends on (i) the **C content** of the plant, which varies according to species and phenological stage, and (ii) the **biomass** produced, which depends on the species, varieties and practices used

→ *A better knowledge of the* **phenology of service plants** *is necessary to better choose them and thus optimize their performance*

→ *Plant breeding efforts on these plants now offer a wide range of possibilities that should be mobilized to* **redesign agroecological systems that store C in the soil**

Thank you for your attention.



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