

# 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

#### ▶ To cite this version:

Lionel Alletto, Sophie Ducos-Boue, Noémie Gaudio, Guillaume Hustet-Caou, Jay Ram Lamichhane, et al.. What is the potential of cover crops and what do farmers say?. The soil carbon farming network, Climate-KIC, Oct 2021, Webinaire, France. 17p. hal-03964837

### HAL Id: hal-03964837 https://hal.inrae.fr/hal-03964837

Submitted on 31 Jan 2023  $\,$ 

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers. L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Supported by :



## 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 INRAE UMR AGIR

lionel.alletto@inrae.fr

@LionelAlletto









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...

INRA





## > 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

	March	April	May	June .	uly Augu	ıst Sej	ptember	October	November	December	January	February I	March	April
Case 1				Harves	t Sowing	MSCC	Developm	ent period	Destruction	n MSCC				Sowing
Case 2				Harve	t Sowing	MSCC		Deve	elopment p	period		Destructio	on MSCC	Sowing

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



### INRA@

## 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

	March	April	May	June	July Au	gust	September	October	November	Decembe	er January	February	March	April
Case 1				Harve	st Sowin	g MSC	CC Developr	nent period	Destruction	n MSCC				Sowing
Case 2				Harve	est Sowir	ig MSC		Dev	elopment p	period		Destruct	tion MSC(	Sowing
Case 3				Harve	st		Sowing	Dev period	Destruc					Sowing
Case 4								Harv	est Sowin	g MSCC [	Development	period De	est. MSCO	Sowing

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







A wide range of sowing and destruction periods of MSCC
Depending on: cropping system, main goals, soil and climate

### some examples of insertion of MSCC in cropping systems

	March	April	May Ju	une Ju	ly August S	eptember	October	November	December	January	February	March	April
Case 1				Harvest	Sowing MSCC	Developm	ent period	Destruction	n MSCC				Sowing
Case 2				Harvest	Sowing MSCC		Deve	elopment p	period		Destruct	ion MSCC	Sowing
Case 3				Harvest	I	Sowing [	Dev period	Destruc					Sowing
Case 4							Harv	est Sowin	g MSCC De	velopment	period De	st. MSCC	Sowing
Case 5		Sov	ving MSCC	Harvest		D	evelopmer	nt period			Destructi	ion MSCC	Sowing

**Case 5**: implantation of the cover inside the cash crop at the end of its cycle *ex. clover sown within a soft wheat* 

conditions, ...



A wide range of sowing and destruction periods of MSCC
Depending on: cropping system, main goals, soil and climate

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

### some examples of insertion of MSCC in cropping systems

	March	April	May Ju	une Jul	y August	September	October	November	December	January	February	March	April
Case 1				Harvest	Sowing MS	CC Developm	nent period	Destruction	n MSCC				Sowing
Case 2				Harvest	Sowing MS	CC	Deve	elopment p	period		Destruct	ion MSCC	Sowing
Case 3				Harvest		Sowing	Dev period	Destruc					Sowing
Case 4							Harv	est Sowin	g MSCC De	velopment	period De	est. MSCC	Sowing
Case 5		Sov	ving MSCC	Harvest		D	evelopme	nt period			Destruct	ion MSC(	Sowing
Case 6		Sowir	ng Sowing I	MSCC	Developmer	nt period 1	Harv	est D	evelopmer	nt period	2 De	st. MSCC	Sowing

**Case 6**: early undersown cover crop in a cash crop *ex. Crimson clover undersown in maize at the 6-8 leaf stage* 





#### INRAe

## > A wide range of sowing and destruction periods of MSCC

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



### **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)

	July	August	September	October	November	December	January	February	March	April
Case 3	Harvest		Sowing	Dev peric	d Destruc					Sowing

*Example 2* : C content in aerial tissues of relay cover crops (sorghum  $\rightarrow$  fababean)

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

June	e July	August	September	October	November	December	January	February	March	April
Case 7	Harvest		MSCC 1			N	1SCC 2			Sowing



#### INRAO

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



### INRA@

### **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



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



▶ 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)

INRAe

### **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

## What is the potential of cover crops and what do farmers say? 22/10/2021

INRA@



- 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

 $\rightarrow$  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

 $\rightarrow$  A better knowledge of the phenology of service plants is necessary to better choose them and thus optimize their performance

 $\rightarrow$  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.



