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## The Impact of Catch Crop Mixture Composition and Management Practices in a Changing Climate

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## What challenges were addressed?

The holistic approach of the study - to improving soil and plant growth technologies:

- restoring soil productivity;
- mobilizing and storing nutrients;
- organic matter;
- stabilizing physical properties;
- optimizing moisture;
- reducing productivity fluctuations.

## What innovative solution were developed/tested?

The technological prototype to show how to correctly (without losses) use the green mass of catch crops for fertilisation.



# Experimental sites

10 field trials were established in farmers' arable lands, following a wide range of methodological guidelines that reflect Lithuanian agricultural conditions, including soil characteristics, farming practices, and farm specialization.



## **Farmers indicated practical problems in growing catch crops:**

1. Short sowing time for catch crops (CC).
2. Unstable yield/biomass of CC.
3. CC evaporates a lot of moisture.
4. It is difficult to insert a large mass of CC.
5. Ripens seeds and self-sows.
6. In spring, the soil is covered with plants, soil dries longer, spring sowing is delayed.
7. Commonly spring crop harvest decreases after the insertion of CC mass.
8. Unclear phytosanitary issues.

# The value of the CC mixture does not depend on the number of plants species, but on the function of each component

1. Soil Coverage Intensity:  
Mustard and Radishes > Oats > Phacelia);
2. Root Structure, Depth, and Mass;
3. Nutrient Uptake, Biomass;
4. Phytosanitary Function.



1. The plant species selected matches the requirements of the cultivation goals and site conditions.
2. The mixture did not contain unsuitable components.
3. The seeds used in the mixtures were of high quality.

# Catch Crop Mixtures

Frost-Tolerant and  
Decomposing CC Mixture:  
*for direct spring sowing in  
rapeseed rotation*

1. Phacelia
2. Buckwheat
4. Egyptian Clover
5. Persian Clover

Brassicaceae CC mixture:  
*to reduce the amount of mineral  
nitrogen remaining in the soil  
after abundant fertilization of  
main crop*

1. White Mustard
2. Forage Radish

Multispecies CC mixture:  
*to increase soil vitality:*

1. Common oat
2. Flaxseed
3. Common vetch
4. Narrow-leaved Lupin
5. Black oat
6. Italian ryegrass
7. Lentils
8. Persian Clover
9. Egyptian Clover
10. Phacelia
11. Common Sunflower

# The growth of catch crop aboveground biomass is most often limited by the interaction between meteorological conditions and agronomic practices.

Years	Month	Average daily temperature (T), °C	Precipitation amount, mm	Number of days			General crop description
				T<10 °C	T<5 °C	T>9 °C	
2019	August	17,0	58.9	2	0	49	Good yield, flowering period on 21 <sup>st</sup> of September
	September	13.8	57.0	14	5		
	October	10.5	34.1	22	9		
2020	August	22.1	26.7	0	0	62	Low yield, no flowering period by 10 <sup>th</sup> of October.
	September	16.2	17.7	0	0		
	October	12.2	60.6	8	8		
2021	August	17.6	176.0	5	0	55	Low yield, flowering at the beginning of November.
	September	13.2	34.7	23	8		
	October	10.5	32.3	28	13		
2022	August	21.9	70.8	3	0	61	Low yield
	September	13.2	22.1	28	15		
	October	11.3	24.6	27	8		
2023	August	21.8	133.3	2	0	60	Good yield
	September	19.5	9.7	7	1		
	October	8.6	78.0	26	15		



# The accumulation of nutrients in CC mass depends on the crop yield

1st experimental year

Mixture	Mass, kg ha <sup>-1</sup>	C	N	K
		kg ha <sup>-1</sup> DM		
Frost-Tolerant CC mixture	<b>1000</b>	402	29	46
Multispecies plant mixture	<b>585</b>	255	21	25
Brassicaceae CC mixture	<b>1388</b>	570	45	67

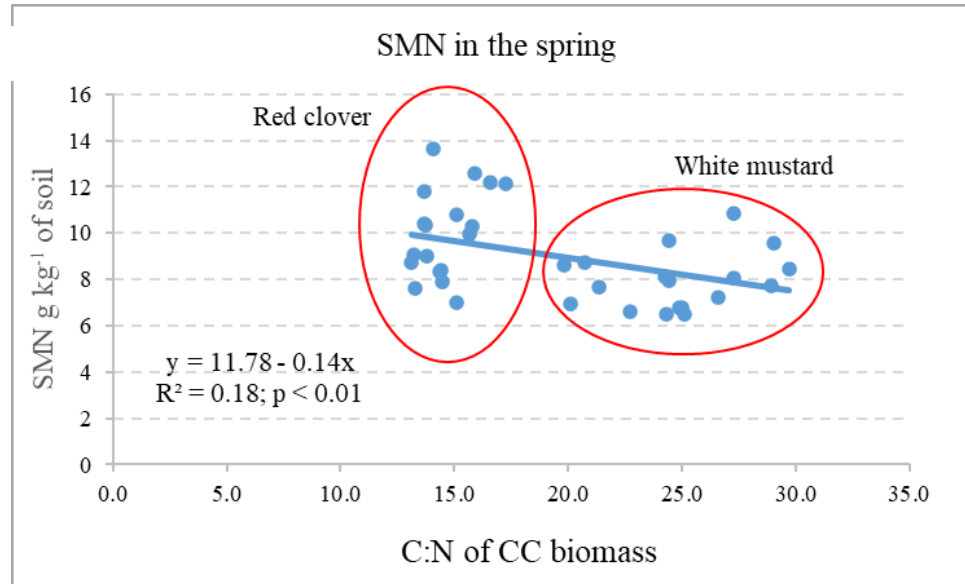
2nd experimental year

Mixture	Mass, kg ha <sup>-1</sup>	C	N	K
		kg ha <sup>-1</sup> DM		
Frost-Tolerant CC mixture	<b>3238</b>	84.1	16.4	11.5
Multispecies plant mixture	<b>2163</b>	58.2	11.3	62.9
Brassicaceae CC mixture	<b>3476</b>	83.2	18.6	119.2

## Concentration of NPK (nitrogen, phosphorus, potassium) in the above-ground biomass of TP plant mixtures and the mineralization rate (C:N).

Site/municipality	CC mixture	Nutrients, %			C, %	C:N
		N	P	K		
Šilalė	Frost-Tolerant	3.16	0.572	5.04	31.8	10.1
	Brassicaceae	3.42	0.614	5.64	33.4	9.8
Klaipėda	Frost-Tolerant	2.92	0.471	3.93	31.5	10.8
	Brassicaceae	3.20	0.419	3.65	32.0	10.0
	Multispecies	3.16	0.393	3.45	33.4	10.6
Pasvalys	Frost-Tolerant	2.90	0.027	4.58	40.2	13.9
	Brassicaceae	3.26	0.52	4.80	41.1	12.6
	Multispecies	3.63	0.064	4.33	43.6	12.0
Pakruojis	Frost-Tolerant	2.44	0.071	4.45	43.7	<b>17.9</b>
	Brassicaceae	2.65	0.032	0.56	38.6	14.6
Alytus	Frost-Tolerant	2.12	-	-	37.6	<b>17.74</b>
	Brassicaceae	3.18	-	-	21.6	6.79
Šakiai	Frost-Tolerant	2.40	-	-	42.8	<b>17.8</b>
	Brassicaceae	2.66	-	-	45.1	<b>17.0</b>

# Dependence of mineral nitrogen on the C:N ratio of catch crop biomass



# Methods of incorporating catch crop biomass and spring crop sowing

- Autumn plowing and conventional spring sowing
- Autumn shallow tillage and conventional spring sowing
- Spring shallow tillage and conventional sowing
- Strip sowing in spring or direct sowing

# Spring wheat after different catch crop incorporation methods

Autumn

Plowed



Spring

Shallow tillage before sowing



Incorporated by shallow tillage and conventional sowing

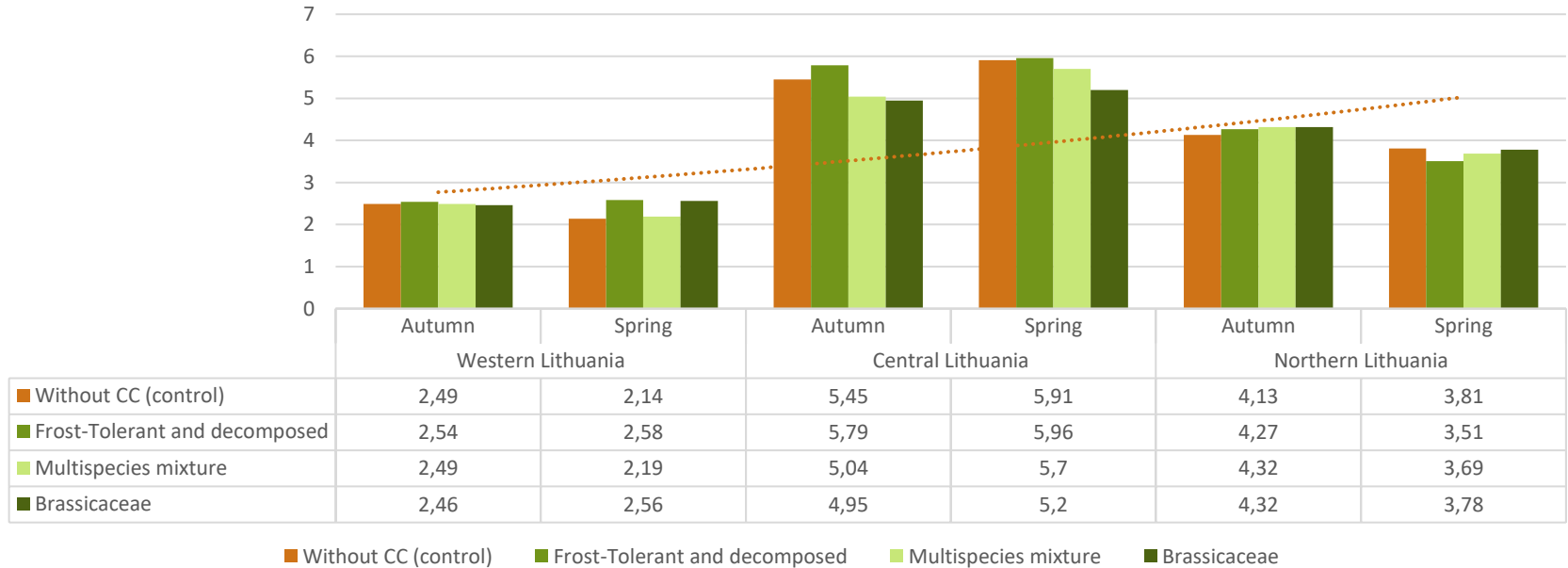


Strip sowing



# Spring wheat yield (t ha<sup>-1</sup>) using shallow incorporation of catch crop biomass in autumn and spring

Spring wheat yield, t ha<sup>-1</sup>



# Take home message

Studies have shown that plants for the mixture need to be chosen according to the functions. Their decomposition intensity depends on mass of CC inserted, its quality, the time of decomposition (autumn or spring), soil and meteorological conditions.

## Thank you!

