Biogas production by co-ensiling catch crops and straw, effect of substrate blend and microbial communities

IWA World Conference on Anaerobic Digestion
Accelerating natural cycles with anaerobic digestion

Introduction

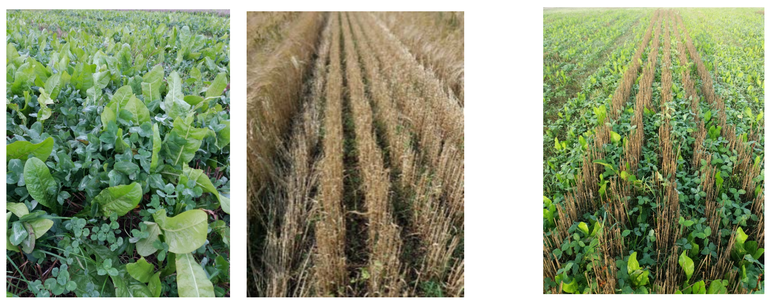
The combination of catch crop (CC) and barley straw (S) for biogas production was investigated in order to evaluate the ensiling process in batch assay and in continuous process. Based on two new agriculture strategies designed to produce energy and improve nutrient cycling in organic farming are being evaluated, one of them consisting on the harvest of straw and catch crop in different periods whereas the other strategy consists on harvesting them at the same time. Catch crops is promoted to reduce nutrient leaching during rainy season and straw that is not used for animal feeding or bedding is generally left in the field. Mixtures of CC and S provides several advantages: 1) Provides adequate TS for silage, 2) Absorbs the silage effluent, 3) Produces high LAB activity, and 4) Provides an optimal C/N for anaerobic digestion (AD). The effect of feeding compositions (straw or manure addition) on the microbial community structures were also investigated.

Material and Methods

Harvest-Summer and Autumn vs Autumn

Separately
Catch crop (CC) + High Straw (S_H)

Together
Catch Crop (CC) + Low Straw (S_L)



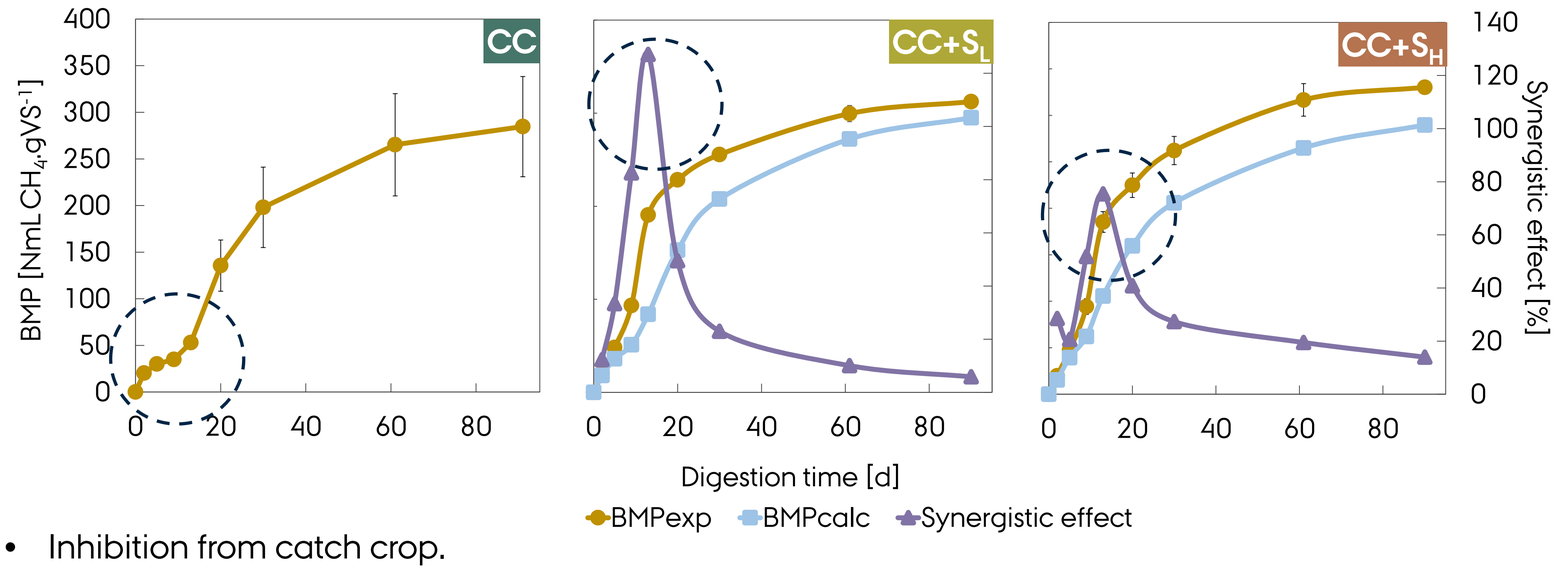
Enisling-3 months storage

Anaerobic digestion-Batch and Continuous

52°C, 90 days
ISR=1

51°C, 25 days HRT, 15L CSTR
Co-AD with diluted cattle manure (M)

Batch test

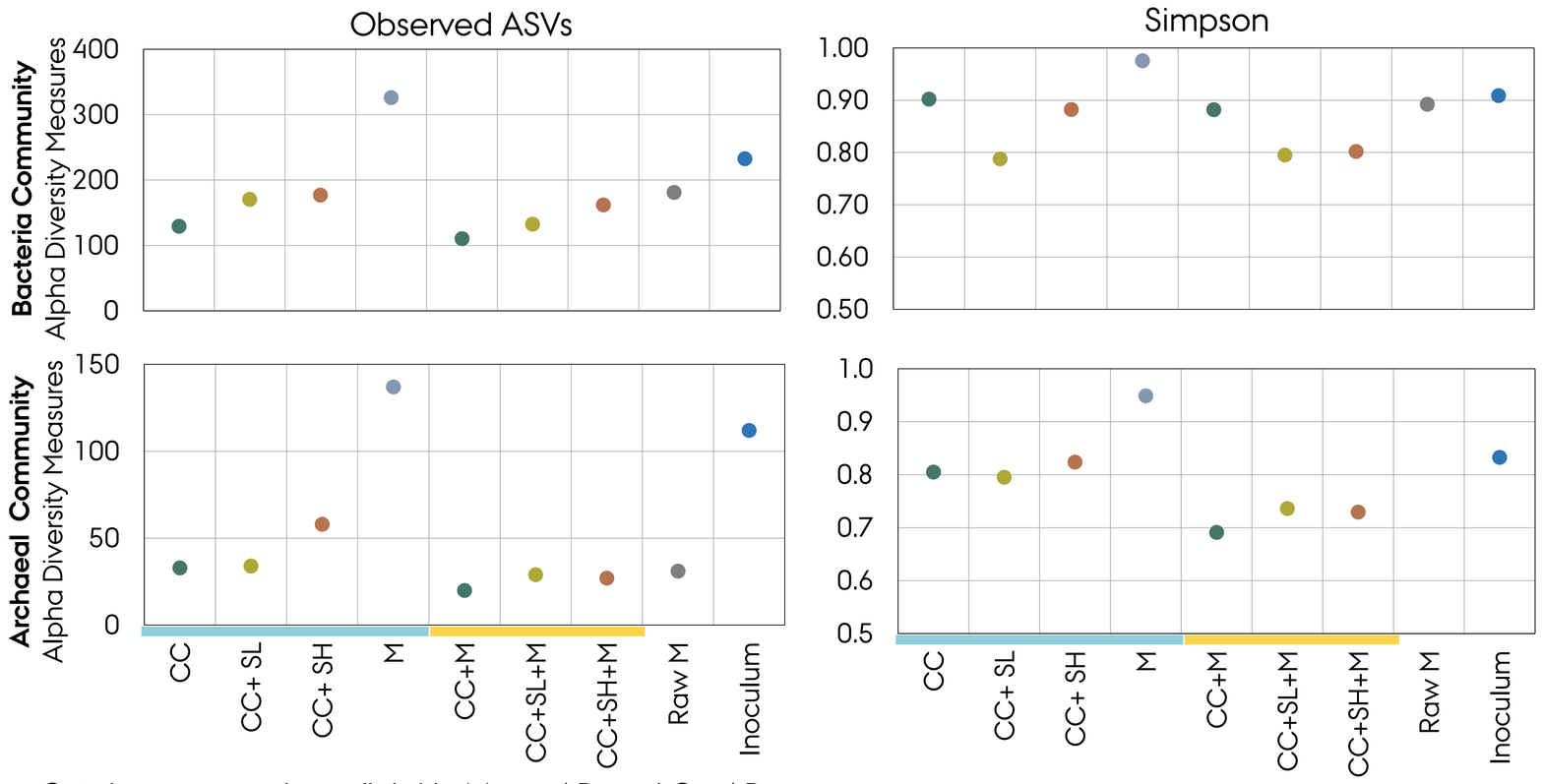


- Inhibition from catch crop.
- Co-ensiling of catch crop and straw had synergistic effect on both biogas yield within short term.

Continuous Process

Parameter	Unit	Mono-AD				Co-AD		
		CC	CC+S_L	CC+S_H	M	CC+M	CC+S_L+M	CC+S_H+M
SMY[a]	[NmLCH_4.gVS^{-1}]	266	220	202	212	269	244	238
RMP[b]	[%]	17	29	34	24	17	23	32
Synergistic[c]	[%]	-	-	-	-	-4	22	31

[a] SMY: Specific Methane yield. Calculated as average of the last 10 days.
[b]RMP: Residual Methane Potential. RMP [%]=RMP/(SMY+RMP)*100. [c]Synergistic effect between biomass and manure.



- Catch crops was beneficial in Mono-AD and Co-AD.
- Co-AD improved degradation of straw.
- At higher straw content, more microbial diversity.

Energy Perspective

Types of digestion	Strategy	Straw addition	SMY [NmLCH_4.gVS^{-1}]	Biomass yield [ton VS. ha^{-1}]	Total Energy output [Nm^3 CH_4.ha^{-1}]
Mono-AD	Only CC	-	266	1.2-2.2	319-585
	Harvest separately	High	220	3.4-6.1	748-1342
	Harvest together	Low	202	2.0-3.6	404-727
Co-AD	Only CC	-	269	1.2-2.2	323-592
	Harvest separately	High	244	3.4-6.1	830-1488
	Harvest together	Low	238	2.0-3.6	476-857

Conclusion

- Catch crop is suitable for anaerobic digestion with either straw, manure or both.
- Microbial community were affected greatly by the feeding compositions.
- Harvest separately strategy seems to be the best for conservation of VS and subsequent methane production.

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