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FERTILIZER N EFFECTS ON SILAGE QUALITY OF GRASS-LEGUME AND HERB MIXTURES

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Introduction

- Climate change adversely impacts grassland yield, stability and feed availability.
- Plants grown in mixtures respond less strongly to drought stress.
- Herbal mixtures not only have good forage qualities but are also suitable for preservation as silage.

Objectives

To evaluate the silage quality of herbal mixtures grown under different nitrogen fertilization levels and assess the effects of a biological silage additive (SA) containing homo- and heterofermentative lactic acid bacteria.

Material & Methods

- Base: Plot trial in Northern Germany (2020-2022) with different forage types and nitrogen fertilization levels 40 (N1) & 220 kg N/ha/year (N2)
- Chosen forage for ensiling: 3rd cut 2022 of Mix 1 (perennial ryegrass & white clover) and Mix 2 (ryegrass, white clover, ribwort plantain & chicory) sown as mixed and strip variants
- Ensiling of wilted forage (35 % DM) in glass jars (n=3) as untreated control (CON) and inoculated with SA (*L. plantarum, P. pentosaceus, L. buchneri, L. kefiri*)
- Analyses of fresh forages: nutritional value, sugar, buffering capacity, nitrate, fermentability coefficient
- Analyses of silages: nutritional value, sugar, DM loss, fermentation & hygienic quality, aerobic stability

Results & Discussion

- 3rd cut 2022:
  - ➢ DM yield between 9.3 dt/ha (Mix 2, N1) – 11.5 dt/ha (Mix 1, N2)
  - ➢ growth with the highest proportion of clover and herbs in the trial period
- Fresh forages: free of nitrate (< 0.3 g/kg DM), sugar ≥ 100 g/kg DM, mean buffering capacity 38 – 51 g lactic acid/kg DM, due to fermentability coefficient ≥ 48 classified as easy to ensile
- ↓ N fertilization levels: ↑ proportion of white clover, ↑ crude protein, ↑ buffering capacity, ↓ sugar (Tab. 1)
- ↑ N fertilization levels: ↑ proportion of ryegrass & ribwort plantain, ↓ crude protein, ↑ sugar, ↑ energy
- High silage quality for both mixtures: strong acidification, minor DM loss (≤ 4.6 %), minor protein degradation, no butyric acid, no molds
- SA: Inoculation led to faster pH decrease, ↑ lactic acid content
- Aerobic storage: most silages without reheating (exception Mix 1, N1, SA) but nevertheless sometimes signs of spoilage

Unexpected finding:

➢ ↑ lactic acid content in mixtures with lower fertilization – similar findings in unfertilized multispecies mixtures reported at literature ?

Tab. 1: Mean values (n=3) of silage quality parameters of grass-legume mixtures (Mix 1) containing additional herbs (Mix 2), cultivated with different N fertilization, after 90 days of fermentation with (SA) or without inoculation (CON).

		MIX 1				MIX 2			
		N1[1]		N2[2]		N1		N2	
Parameters		**CON**	**SA**	**CON**	**SA**	**CON**	**SA**	**CON**	**SA**
DM	[%]	38.0^{a}	35.6^{e}	38.0^{a}	38.5^{ab}	36.5^{c}	38.0^{d}	37.8^{a}	38.8^{b}
Crude ash		9.7^{a}	9.0^{b}	8.2^{c}	7.9^{c}	9.4^{a}	8.7^{b}	7.7^{c}	8.2^{c}
Crude protein		15.5^{a}	15.8^{a}	13.8^{b}	13.5^{b}	15.6^{ac}	15.6^{c}	12.9^{b}	13.9^{b}
aNDFom	[% DM]	38.4^{a}	39.2^{a}	44.4^{c}	43.7^{c}	36.6^{b}	37.2^{b}	43.4^{c}	42.9^{c}
ADFom		28.0^{a}	27.9^{a}	25.6^{b}	25.0^{c}	27.6^{a}	28.0^{a}	24.7^{b}	25.2^{bc}
Sugar		5.8^{a}	5.7^{a}	10.9^{c}	10.5^{c}	5.6^{a}	4.2^{b}	10.6^{c}	8.8^{d}
NEL	[MJ/kg DM]	6.2^{a}	6.1^{a}	6.6^{c}	6.5^{d}	6.1^{b}	6.0^{b}	6.5^{bc}	6.5^{cd}
Lactic acid		5.8^{a}	8.4^{b}	5.4^{e}	7.5^{f}	6.0^{c}	7.7^{d}	4.0^{g}	6.0^{h}
Acetic acid	[% DM]	1.9^{a}	0.8^{b}	1.6^{e}	1.1^{f}	1.4^{c}	1.1^{d}	1.6^{eg}	1.5^{h}
Ethanol		0.5^{a}	0.7^{ad}	0.5^{a}	0.9^{d}	0.6^{b}	0.5^{a}	0.5^{a}	0.4^{c}
pH 3 d		5.1^{a}	4.2^{b}	4.5^{c}	4.3^{e}	4.6^{c}	4.4^{d}	4.5^{c}	4.5^{c}
pH 90 d		4.2^{a}	3.9^{b}	4.1^{a}	3.9^{b}	4.1^{a}	4.0^{d}	4.2^{c}	4.0^{d}

[1]N1= 40 kg N/ha/year, [2]N2= 220 kg N/ha/year

Conclusion

The level of nitrogen fertilization influenced the composition of grass-legume (and herb) mixtures and their nutritional value.
The successfully wilted mixtures exhibited a rapid and substantial reduction in pH, driven by efficient lactic acid production, which was further enhanced by using a biological silage additive.
Adhering to good professional practices is key to producing high-quality silage from these mixtures.

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