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23. Fertilizer quality in source-separated dairy cattle systems

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Introduction

In the search for low-emission livestock systems technical innovations push towards separation of urine and feces, leading to multiple fertilizer products. In earlier research it was found that these products have a different agronomical quality (van Boxmeer et al., 2023). The current project was to find out what the variability and persistence of the fertilizer quality of these innovative dairy systems is over a growing season.

Methodology

In the period from February 2024 to November 2024 samples were taken from five dairy systems. All fertilizer products that were produced were sampled. In total 5 samples per dairy system were taken and analysed over the growing season. Samples were analysed for Dry matter (DM), Organic matter (OM), Nitrogen (N), Mineral Nitrogen (N_{\min}), Phosphate (P_2O_5) and Potassium (K_2O) to determine the agronomical quality of all fertilizer products.

Table 1. Average fertilizer quality and variability (SD in brackets) of manure products from five dairy systems.

Name	Products	DM g/kg product	OM g/kg DM	N g/kg DM	N_{\min} g/kg DM	P_2O_5 g/kg DM	K_2O g/kg DM
1. Slatted floor with air scrubber	Slurry	100.6 (± 5.7)	801.6 (± 61.9)	38.3 (± 3.3)	9.9 (± 4.9)	16.2 (± 1.6)	36.2 (± 15.6)
	AS ¹	171.2 (± 12.6)	-	187.4 (± 16.2)	192.2 (± 18.1)	0.0 (± 0.0)	1.1 (± 0.3)
2. Mono-manure-digester with processing	Solid digestate	339.5 (± 13.3)	856.3 (± 43.3)	25.5 (± 0.7)	8.7 (± 0.6)	24.5 (± 2.0)	14.0 (± 0.5)
	AS ¹	297.4 (± 5.3)	-	204.2 (± 2.9)	208.6 (± 5.8)	0.0 (± 0.0)	0.0 (± 0.0)
	Effluent	41.4 (± 4.0)	632.4 (± 30.2)	74.3 (± 13.0)	39.6 (± 10.2)	27.9 (± 4.2)	104.1 (± 6.5)
3. Source separation and fermentation	Urine	27.3 (± 0.9)	408.3 (± 37.8)	102.7 (± 4.8)	89.2 (± 4.6)	4.7 (± 0.7)	288.6 (± 6.4)
	Fermented manure	160.7 (± 16.4)	644.2 (± 218.9)	25.8 (± 3.4)	6.6 (± 1.0)	11.9 (± 1.8)	25.8 (± 2.7)
4. Source separation mono-manure digester with processing	Solid digestate	302.9 (± 31.1)	873.4 (± 94.9)	22.0 (± 1.4)	8.7 (± 0.9)	16.6 (± 1.9)	13.9 (± 1.1)
	AS ¹	204.1 (± 25.1)	-	191.1 (± 37.7)	196.4 (± 39.9)	0.1 (± 0.0)	0.8 (± 0.2)
	Effluent	48.2 (± 0.1)	582.6 (± 3.5)	83.3 (± 3.8)	50.5 (± 4.5)	23.4 (± 0.0)	98.8 (± 6.5)
5. Source separation with rubber floor	Urine	38.8 (± 6.6)	639.4 (± 120.7)	65.2 (± 5.8)	44.2 (± 3.3)	13.9 (± 2.3)	117.3 (± 11.0)
	Feces	106.8 (± 9.0)	646.2 (± 281.7)	32.4 (± 2.2)	7.9 (± 0.4)	13.8 (± 0.4)	27.8 (± 2.3)

¹AS: Ammonium Sulphate

Results and discussion

Table 1 shows the average concentration of DM, OM, N, Mineral N, P_2O_5 and K_2O of the different fertilizer products in five innovative dairy systems. All systems produce two or three different fertilizer products, that show distinct differences in fertilizer quality. The solid digestates show a high organic matter content (>850 g/kg DM), whereas the fermented manure showed comparable results as slurry. The Ammonium sulphate (AS) in all three systems with an air scrubber or ammonia stripper contained mainly mineral Nitrogen with around 200 g N_{\min} /kg DM. The concentration of N_{\min} per kg product varied between systems (3,2% -6,2%), mainly due to the DM content of the product. Urine and effluent fractions contain relative high concentration of Potassium. Analysis is needed how these products reach the RENURE-criteria and how all products could fit into a balanced fertilizer scheme on the dairy farm.

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