

Monitoring Seasonal Changes of Methane and Carbon Dioxide Emissions in Dairy Cattle Farming Under Warm Climate Conditions*

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In this study, greenhouse gases (CH₄ and CO₂) in the sample dairy farm were measured for a year on 5 emission points: barn, paddock, slurry manure tank, separated liquid manure lagoon and separated solid manure pile, and their seasonal changes were monitored (Fig.1 and Fig.2).

Emission measurements were made with a Smart Trace Gas Analyzer, which works according to the "flow chamber" method, on each emission point, on average every 15 days, with 3 repetitions, for a total of 360 measurements. The highest CH₄ and CO₂ emission values at emission points were measured as 415,916 CH₄- $\mu\text{mol}/\text{m}^2/\text{s}$ (30 ağustos 2023) and 2,314.8 CO₂- $\mu\text{mol}/\text{m}^2/\text{s}$ in the solid manure pile in the summer (August 30, 2023). Although there is generally a seasonal increase in the emissions measured at each point depending on temperature, dramatic increases occurred in the separated liquid manure lagoon. The seasonal average of CH₄ emissions for lagoons in the summer season (36,350 CH₄- $\mu\text{mol}/\text{m}^2/\text{s}$) was determined to be 4.8 times higher than in the winter season (7,577 CH₄- $\mu\text{mol}/\text{m}^2/\text{s}$) (Table 1).

The results of Pearson-r correlation analysis of emission measurements showed that there was a significant seasonal effect on CH₄ emissions in solid manure ($r=0.545^{**}$, $p<0.01$, $N=72$) and liquid manure storages ($r=0.534^{**}$, $p<0.01$, $N=72$), depending on temperature change. However, there is no seasonal effect ($p > 0.05$) was detected on CH₄ emissions in the shelter, paddock and slurry manure tank and on CO₂ emissions at all emission points.

All these results have shown that high levels of emissions occur from solid and liquid manures stored open to the atmosphere at high temperatures, especially in dairy cattle farms in warm climate regions such as Türkiye. In such climatic regions, there is a need to develop manure management strategies for mitigation of emissions in dairy farming.



Figure 1. Emission measurement points in dairy farm

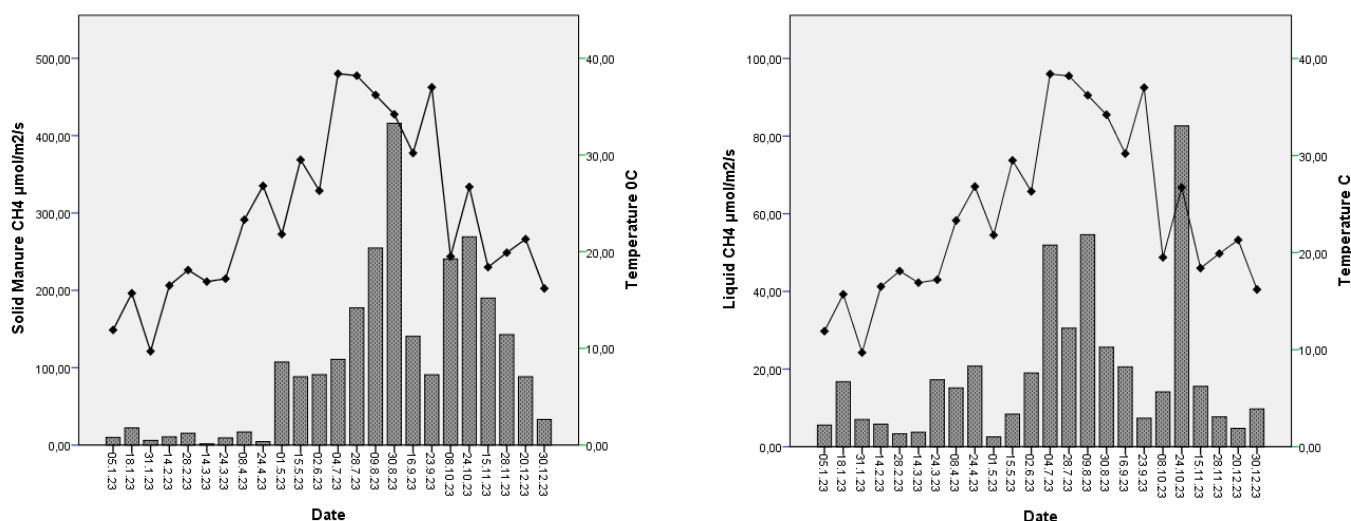


Figure 2. Variation of CH₄ Emissions during the year in solid and liquid manure

Table 1. Seasonal variation of measured CH₄ and CO₂ emissions

measurement points	Seasonal CH ₄ Emission (µmol/m ² /s)				Seasonal CO ₂ Emission (µmol/m ² /s)			
	Vinter	Spring	Summer	Fall	Vinter	Spring	Summer	Fall
Paddock	0,515	0,657	0,775	0,398	27,19	54,12	52,66	27,40
Barn	0,690	0,699	0,757	0,431	31,80	44,15	27,50	15,17
Slurry	14,955	6,368	15,138	37,511	87,60	119,77	21,44	73,80
Liquid	7,577	11,311	36,350	28,047	39,93	111,08	22,48	25,18
Solid	41,081	38,049	209,954	186,268	689,10	839,27	1.125,76	1114,05

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