MIKROBIOM-LAB.DE

Customer:
Plocher GmbH
Meersburg

Kind of analysis:
Bacterial 16s rDNA Analysis (NGS-Sequencing)

Sample:
Caddle slurry

GÜLLE DNA
MIKROBIELLE GÜLLE ANALYSE

Execution: Mikrobiom-Lab, Peter Gockel

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Report DNA-Analysis of cow slurry

1 Description of the analysis

A slurry evaluation with NGS sequencing based on the 16S rDNA method with Illumina MiSeq was carried out. The bacterial microbiology of the delivered manure sample was analysed and evaluated. The results can be found in this report. In addition, you will receive an Excel list with all species.

2 The executing laboratory

The corresponding analyses were carried out at the Mikrobiom-Lab, 97723 Oberthulba (Bavaria, Germany), www.mikrobiom-lab.de.

The laboratory specialises in bacterial and fungal DNA analyses from agriculture in the areas of soil, leaves, liquid manure and biogas. It is also a partner of geotechnical offices in the field of environmental microbiology, ecotoxicology and pollutant screening.

The Microbiome Lab team can assign the microbial communities present to specific soil/leaf functions and thus evaluate the microbial performance of a sample (e.g. nitrogen fixers, plant growth-promoting bacteria, etc.) on this basis.

3 Summary

1. Species diversity: This slurry shows high numbers of individuals (measured 178303, reference 150,000) with average species diversity (measured 228 species, reference 250 species).
2. Top development of bacteria known as plant growth promoters. These are also highly P-dissolving, have an apathogenic effect and improve the soil.
3. There are almost no pathogens, especially no nasty clostridia.
4. Extremely high rate of butyric acid-producing bacteria. This is great because butyric acid in the soil is THE energy supplier for biology.
5. High denitrification - this means LOTS of CO2 formation, which is why the Plocher slurry bubbles.
6. Extremely high production rate of vitamin b12-producing bacteria, which means very good bacterial processing of iron, sulphur, molybdenum and cobalt.
7. Litter degradation - carbohydrates, cellulose, lignin: Litter degradation is well achieved, cellulose degradation is almost complete. This should result in a very homogeneous slurry. Floating layers are hardly to be expected.
8. Very low sulphur and methane content, as there are very few bacteria present to break this down, so S and CH are already bacterially bound.
9. Proteobacteria - are well represented, important when spreading because they heal the soil. Most soils have too few of them and your slurry now brings an extra portion into the soil.
10. The top bacteria speak a clear language. There are aerobic and anaerobic bacteria in the mix, even among the dominant species, but this is quite normal in slurry. What is important, however, is that ALL important metabolic processes are represented by the top 5 bacteria. - Conversion of carbohydrates into sugar and acetic acid - conversion of proteins and amino acids - fermentation processes - CO2 formation processes - growth of these bacteria even at plus 4°C - survival even in dry conditions, temperature fluctuations. - Production of SCFA, short-chain fatty acids (acetic acid, propionic acid, butyric acid)
11. Nitrogen fixers are formed in the slurry, which are helpful later after spreading.
12. Nitrification: There is no conversion of ammonium into nitrite and nitrate, but denitrification (CO2 formation) takes place
13. Very good: 5% proportion of pesticide-degrading bacteria, which helps farmers to break down molecular residues from crop protection more quickly
14. Plant growth promoters - top - twice as many as the target value for slurry, the same applies to P solubility.
15. It also contains siderophores, which reduce the fixation of iron at elevated pH values and thus make Fe soluble again after application.

4 Bacterial comparison

We compare reference data from cattle manure according to WANG 2018 in this list with their samples at the higher phyllum level. Only the relevant groups are shown.

Bacteria TOP Phylum Level

Phylum	**Plocher cow slurry**	Cow slurry, reference data WANG 2018
Acidobacteria	0,01 %	0.1-13.4%
Acidobacteriota		
Actinobacteriota	0,04 %	0.2-22.1% (Median 0,5%)
Actinobacteria		
Proteobacteria	11,07 %	> 6 %
Alphaproteobacteria (pH-Indicator)	0,6 %	pH < 7,4 = <1%, pH >7,4 = > 1%
Deltaproteobacteria (Sulfatdegrader)	0,3 %	
Gammaproteobacteria (soil health)	9,7 %	Target > 8%
Bacteroidetes	21,89 %	8,5 - 28%
Bacteroidota		Median 20%
Firmicutes	35,78 %	(22-60%), 29,8% Median (Clostridia dominant 29%)
Cloacimonetes	1,33 %	<2%

The organic matter, total N and total P content in the soil are very positively influenced by the Proteobacteria and the Bacteroidetes. At the same time, the levels of Acidobacteriota should be low (ZHAO 2022), which in turn improves C availability.

The compilation of the above data shows a favourable distribution of the bacterial community in the present manure. We describe the condition of a slurry as ‘favourable’ if its microbiome has the most favourable possible effect on the soil biology present there after application to the field (promotion of plant growth, suppression of pathogens, improvement of nutrient availability, solubility of Fe, solubility of P, promotion of nitrification and nitrogen fixation, etc.). The details are presented in this report.

Acidobacteria

This group of bacteria prefers pH values in the range 6.4 to 7.2 with a growth optimum at 6.9-7.2. The absence of this group is due to a higher pH where they cannot survive. For this reason, the Acidobacteria are absent in this slurry. In many conventional soils there is an excess of Acidobacteria. These then inhibit the availability of carbon, which is considered undesirable. Therefore, in many cases it is positive if slurry contains low to very low levels of Acidobacteria.

Actinobacteria

Basically, actinomycetes build up a kind of antibiotic protective shield and contribute to the inhibition of pathogens such as Shigella, Escherichia, Salmonella, Listeria, Chlamydia and Campilobacter. The proportion of Actionobacteria in the slurry is usually low, with a median of 0.5%. In the present slurry sample, the content is also low, but there is a high level of pathogen protection for other reasons.

Proteobacteria

The Proteobacteria group includes many beneficial bacteria, including the N-fixers and the group of plant growth-promoting bacteria, the P-solubisers and the vitamin B12 formers. This group also contributes to the improvement of nitrification.

This slurry has a good proportion of this group of bacteria and the most important subgroup of Gammaproteobacteria is also well represented here.

The most important representatives of Proteobacteria in this slurry are Pseudomonas 5% (ZHAO 2022) and Acinetobacter 3%.

These play an important role in pathogen defence, the release of P from the soil, are important plant growth promoters and produce phytohormones (ZHAO 2022).

High levels of Proteobacteria are important for pathogen defence and further promote the proportion of Proteobacteria in the soil after application to the field (ZHANG 2023). This group of bacteria contributes the most to the development of improved soil fertility compared to all other groups of bacteria.

Alphaproteobacteria (Proteobacteria subgroup)

This group is an indicator of higher pH values. In the present sample, however, there are only very small proportions that indicate a lower pH < 7.2. However, the measurement of this slurry pH was not the subject of our investigation.

Deltaproteobacteria (Proteobacteria subgroup)

This group primarily includes sulphate degraders and sulphur degraders. At 0.3%, it can be seen that there are hardly any sulphur residues left and that the slurry has therefore reached a favourable environment for spreading.

Gammaproteobacteria (Proteobacteria subgroup)

The higher the proportion of Gammaproteobacteria, the better the nitrification process (ZHAO 2016). This group basically stands for the promotion of soil health 'bioremediation' after the slurry has been spread. It has antibacterial properties with a pathogen-repellent effect. This group should account for approx. 80% of all Proteobacteria groups in liquid manure. In this slurry, their proportion is even more than 90%.

Bacteroidetes (litter degradation - Cellulosis)

This important group is responsible for the breakdown of cellulose, hydrolysis and VFA production. VFA = 'volatile fatty acids', which are important for a well-functioning metabolism in the manure. This group is represented above average.
The median of the reference values is 20%, their slurry is at an elevated 21.9%.

The higher the proportion of Bacteroidetes, the better the cellulose degradation.
This makes it easy to see that cellulose degradation works well. At the same time, low values in the Cloacimonetes group < 2% indicate that cellulose degradation is complete. In contrast, higher values for Cloacimonetes > 2% indicate that litter degradation is still active. The values may well be higher than 13%.

According to ZHAO 2022, a high proportion of Bacteroidetes also contributes to the fact that the slurry has a positive effect on biomass and nutrient availability in the soil after application.

Firmicutes (litter degradation - carbohydrates)

This group of bacteria breaks down proteins and carbohydrates (Lim et al., 2014). Firmicutes can also produce key enzymes such as protease or lipase, which in turn facilitate the breakdown of litter (Chen et al., 2019). The median proportion of Firmicutes is 29.8%. Their slurry sample is 35.78, thus showing significantly more favourable values than the reference.

Bacterial litter degradation

	Bacteroidetes	**Cloacimonetes**	**Firmicutes**
Type of litter degradation	Degradation of cellulose	Degradation status of cellulose and amino acids'	Carbohydrates, proteins
Reference Median	20 %	cellulose is degraded <2%. Cellulose is still degraded >2%	29,8 %
Your values	21,9 %	1,3 %	35,8 %
Change	**9,5 %**	Cellulose is degraded	**20 %**
	This slurry shows significantly better degradation rates for carbohydrates and cellulose as well as for the conversion of proteins as a result of the treatment.		

However, elevated levels of Cloacimonetes are also to be expected in the digestate from biogas plants in the final repository.

5 Top bacteria at GENUS level

The top dominant bacteria at the GENUS level provide an overview of the most important functions of this slurry.

Top bacteria at GENUS level

GENUS	**17,0 %**	
Pseudomonas	**5,0 %**	Gammaproteobacteria. Aerobic. Plant growth promoter and good pathogen defence, releases bound P and Si from the soil. Is the most outstanding group in this report, especially the species Pseudomonas caeni, which leads to high values.
UCG-002	**4,0 %**	Phyllum Proteobacteria. Family Succinivibrionaceae. Anaerobic. Degradation of carbohydrates
Acinetobacter	**3,0 %**	Gammaproteobacteria. Aerobic. Decompose organic matter saprophytically. Break down toxic substances. Are biostimulants and pathogen defence. Survive drought, low pH and large temperature fluctuations.
Anaerocella	**2,8 %**	Bacteroidetes. Typical in cattle farming. Anaerobic. Increased levels = improved fatty acid production (VFA). It improves the solubility of organ. Substance and the amount of fermenting bacteria increases. A. Is the mediator for this.
Sedimentibacter	**2,2 %**	Firmicutes, Clostridia. Anaerobic. pH optimum 7.0 - 8.2. Degrades amino acids to ethanol and organic acids. (Lechner, 2015;Imachi et al., 2016)

Pseudomonas, UCG-002 and the Acinetobacter reflect the soil-important group of Proteobacteria.

Anaerocella and Sedimentibacter reflect the litter decomposition and both groups show due to their dominance that the litter decomposition has worked very well by the treatment with Plocher.

6 Top bacteria on species level

The five most important species provide a good insight into the state of the existing slurry.

Top bacteria SPECIES level

Species	Share (%)	Description
Pseudomonas caeni	4,8 %	Core property: significant denitrifier, with reduction of nitrate and nitrite. Widespread in liquid manure. Only grows in low-salt slurry (< 3% NaCl). Also grows at 4°C. Opt. pH 7.0-8.0.(XIAO 2009)
UCG-002 trichiura	4,0 %	Phyllum Proteobacteria. Family Succinivibrionaceae. Anaerobic. Conversion of carbohydrates into acetic acid
Anaerocella delicata	2,8 %	Bacteroidetes. Fermenters. Anaerobic, methanogenic. Typical for cows. pH optimum 6.8-7.5 Temperature range 10-37°C, optimum 25-30°C. Produces indole (manure odour). Converts proteins and amino acids, but not sugars.
Fermentimonas caenicola	2,2 %	Phyllum Bacteroidota, grows optimally at 37°C, pH range 6.5-8.5 with optimum at pH 7.1. Salinity tolerant 0-5 gr/l NaCl. Facultatively anaerobic. Typical fermenter. Conversion of carbohydrates into sugars and conversion of complex carbohydrates. Methane producer. Yeasts stimulate growth. Produces acetic acid, propionic acid and CO2 (MIDAS Field Guide)
Acinetobacter lwoffii	2,0 %	Gamma-Proteobacteria. Aerobic. Widely distributed. Survives drought, low pH and large temperature fluctuations. It hardly reacts to disinfectants. Produces SCFA short-chain fatty acids, breaks down proteins and converts amino acids. Converts carbohydrates into sugar.
Total	**15,8 %**	

7 Butyric acid producing bacteria

In the faeces of cattle and pigs, a healthy intestinal microbiome usually contains 20% propionic acid, 60% acetic acid and 20% butyric acid. Although butyric acid is obviously subordinate, it provides 80% of the total energy for the animal's body. Similarly, butyric acid can be utilised by plants and serves to promote healthy plant growth. Higher levels of butyric acid in the slurry therefore strengthen the plants.

There are no real target values; the content of butyric acid in the slurry depends on several factors, including the feeding of the animals. The butyric acid content in the slurry can also depend on the silage fed. In 1989, ZANGERL found that feeding silage with 38 % DM led to a significantly higher content of butyric acid bacteria spores in the faeces compared to feeding silage with 53 % DM and dry fodder.

In the practice of our everyday laboratory work, we formulate an empirically grown target value of > 2 % butyric acid-producing bacteria in the manure. Above this threshold value, plant-effective changes can occur after the slurry has been applied.

Butyric acid producing bacteria

Bakterium	Description	Share (%)
Bacteroides	Important intestinal microbiome Bacterium	2,14 %
Akkermansia municiphila	Important intestinal microbiome Bacterium, probiotic	0,44 %
Ruminococcus	Important intestinal microbiome Bacterium	0,22 %
Eubacterium	Important intestinal microbiome Bacterium, probiotic	0,21 %
Faecalibacterium Prausnitzii	Important intestinal microbiome Bacterium, probiotic	0,21 %
Prevotella	Important intestinal microbiome Bacterium	0,09 %
Lactobacillus	Important intestinal microbiome Bacterium, probiotic	0,01 %
Clostridis		0,00 %
	Total	3,32 %

Bacteroides, Ruminococcus, Eubacterium and Prevotella are typical intestinal inhabitants in humans and animals.

Akkermansia and Faecalibacterium are partners that always occur symbiotically. They are the key to health in humans and animals. High levels of Faecalibacterium are always an indicator of an existing disease (the values in this analysis are ok).

Lactobacillus, i.e. the lactic acid bacteria, are usually only found to a lesser extent in slurry, but promote the natural acidification of the slurry and thus indirectly bind ammonia.

8 Does your slurry optimisation reduce the clostridia content?

Family	Your sample	Reference Mikrobiom-Lab Stand 31.12.24	Changes (%)	Remarks
Clostridiales	**7,6 %**	**13,5 %**	**-44 %**	A good slurry should have values well above our reference value
Bacteroidales	**17,8 %**	**11,7 %**	**52 %**	Your values should be higher than the reference
Pseudomonadales	**8,1 %**	**1,2 %**	**575 %**	Your values should be higher than the reference
Lactobacillales	**0,4 %**	**0,6 %**		As a rule, the proportion of lactic acid bacteria in the slurry remains low <1%.

Targeted treatment of liquid manure should reduce the amount of clostridia in the liquid manure. This reduces subsequent feed contamination and the introduction of additional pathogenic loads. It is therefore worth looking at the clostridia.

There are 44% fewer clostridia in your sample compared to our reference value. This can be seen as a clear indication of successful slurry treatment.

The presence of soil-important Bacteroidales and Pseudomonadales also increased by 52% and 599% respectively, which can improve essential soil functions after application.

The group of Lactobacillales (lactic acid bacteria) is almost always insignificantly low in slurry, the representation is only informative.

Clostridia contents and mineral fertilised areas

Mineral-fertilised areas produce higher quantities of clostridia in the slurry via the feed. However, the aim of sustainable slurry optimisation should be to keep the proportion of clostridia in the slurry low. Incidentally, the influence between the clostridia content in the silage and the butyric acid content in the silage is small

(https://www.agrarforschungschweiz.ch/wp-content/uploads/2019/12/2017_04_2265.pdf).

9 Nitrogen fixation

Nitrogen fixers are present in the slurry.

Airborne nitrogen-fixing bacteria, also known as nitrogen fixers, play a crucial role in the nitrogen cycle and in biological nitrogen fixation. Nitrogen is an essential nutrient for plants, but most plants cannot directly utilise nitrogen gas (N_2) from the air.
Airborne nitrogen-fixing bacteria can convert this type of nitrogen into a form that plants can utilise. Via the intestinal microbiome of pigs and cattle, these can enter the soil via the manure and supplement and expand the pool of N-fixers there.

There are free-living nitrogen fixers (Azotobacter, etc) and symbiotic nitrogen fixers such as the rhizobacteria on the roots of legumes such as peas, beans or alfalfa (BHAT et.al 2022).

Advantages: The plant's nitrogen availability increases, the need for synthetic fertiliser is reduced and soil fertility improves.

Actual value 1,4%

N-Fixation

VERY LOW (-0,5%)	LOW (< 1%)	MEDIUM (< 1,5%)	HIGH (< 2,5%)	VERY HIGH (>2,5%)
Datenbasis:	Top 109-Bacteria, Stand 31.12.24			

10 Nitrification und Denitrification

Nitrification is the conversion of ammonium into nitrate. This process takes place in two stages. Firstly, ammonium is converted to nitrite (AOB) and then nitrite is converted to nitrate (NOB). Higher values are a sign of increased activity.

However, we often encounter impaired nitrification with low AOB values and high NOB values. This can be an indication of a high level of mineral fertilisation (= nitrate-heavy, therefore high NOB) or an indication of inadequate plant nutrition (= insufficient ammonium supply to the soil).

Description	Info	Bakterium	Share	Total
Ammonium-oxidising bacteria (AOB)	Conversion of ammonium into nitrite	Nitrosomonas	0 %	0 %
		Nitrosospira	0 %	
		Nitrospira	0 %	
Nitrite-oxidising bacteria (NOB)	Conversion of nitrite into nitrate	Nitrobacter	0 %	0 %
		Nitrococcus	0 %	
		Nitrolancetus	0 %	
		Nitrospira	0 %	
Denitrification	Conversion of nitrate into molecular nitrogen (N2)	Pseudomonas	4,98 %	**5,1 %**
		Corynebacterium	0,08 %	
		Geobacter	0,02 %	
		Thiobacillus	0,01 %	

Assessment: Nitrification was not (or no longer) taking place at the time of sampling, as evidenced by the absence of the corresponding bacteria.

However, there is pronounced denitrification, in which CO2 is probably released in visible bubbles on the surface of the slurry. The amount of denitrification present suggests that this is a strong bubble formation.

11 Vitamin B12 producing bacteria 8,2 %

Vitamin B12 has a significant anti-stress effect on leaves and soil: Abiotic and biotic stress factors can be almost completely eliminated by sufficient vitamin B12 in the plant, as vitamin B12 is the complete antagonist of free radicals.
Less stress means better photosynthesis performance.

Vitamin B12 can only be produced by bacteria, but plants benefit from it.

The prerequisite for the production of vitamin B12 by bacteria in the slurry is sufficient quantities of sulphur, iron, cobalt and some molybdenum and, of course, the presence of the corresponding species.

Very high levels of vitamin B12-producing bacteria are found in the slurry in question. These are the highest levels we have ever found in a slurry.

Such high vitamin B12 formation rates also presuppose that the breakdown of carbohydrates and cellulose is favourable, which we have already demonstrated in the chapter on litter breakdown in this report.

Actual value 8,2%

Vitamine B12 producing bacteria

VERY LOW (-0,5%)	LOW (< 1%)	MEDIUM (< 4%)	HIGH (< 7%)	VERY HIGH (>7%)
Datenbasis:	Top 58-Bacteria, Stand 31.12.24			

12 Pesticide-degrading bacteria 5,0%

Pesticide-degrading bacteria can even be found in liquid manure / fermentation residue.

These bacteria have the favourable property of breaking down residual molecules of pesticides more quickly.

As a result, these bacteria also reduce the stress in the plant after the slurry has been applied and the photosynthesis performance improves.

This group is dominated by either the Pseudomonas species or the Bacillus species. The Pseudomonas species dominate in this slurry sample.

Actual value 5,0%

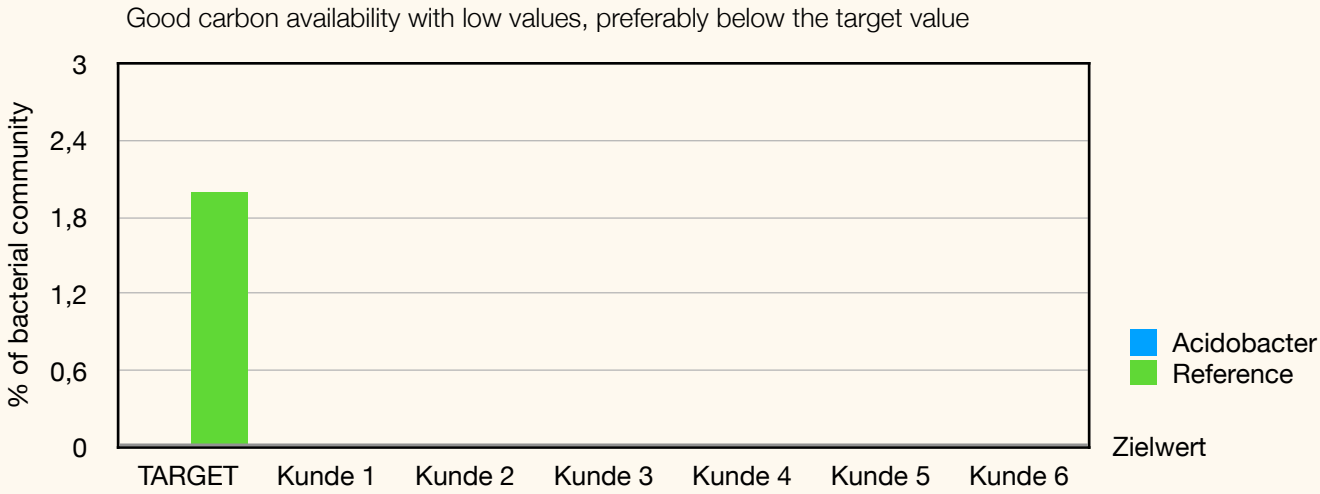
Pesticide reducing bacteria

VERY LOW (-1%)	LOW (< 2%)	MEDIUM (< 3%)	HIGH (< 4%)	VERY HIGH (>4%)
Datenbasis:	Top 118-Bacteria, Stand 31.12.24			

13 Carbon availability- Acidobacter

High amounts of oligotrophic Acidobacteria are characterised by low carbon availability. However, the present slurry sample has a very low proportion of acidobacteria at 0.01%.

Conclusion: The carbon availability of your sample is high, it is clearly below the green target value (=0.01%).



Quelle: https://jacksonlab.stanford.edu/sites/g/files/sbiybj20871/files/media/file/ecol07b.pdf

14 Soil stability and the soil's immune system

The ratio of the bacterial groups Bacteroidetes and Firmicutes to each other is important for soil stability.

If the Bacteroidetes predominate, there are inflammatory processes in the soil - the immune system would then be weakened. Parallel to this finding, there would then be fewer Actinomycetes. Both groups together should account for 50% or more.

Your sample can only provide 17-23% of this power.

	Probe 1		Setpoint CHENG 2020	
Bacteroidetes	21,90 %		> 20%	Too much Bacteroidetes indicates an immunodeficiency in the soil, especially if the proportion of Actinomyces is also too low - see below. Bacteriodetes produce soil-important acids and break down cellulose, so they contribute significantly to the decomposition of organic matter.
Firmicutes	35,80 %		> 30%	Firmicutes should be smaller than Bacteroidetes. Firmicutes produce key enzymes for the decomposition of organic matter.
Total	**58 %**	**0 %**	**> 50 %**	

Is your share 50% or higher?

Their proportions of Bacteroidetes and Firmicutes correspond to the target value of 50% or even higher. This means that your slurry provides a balanced and favourable biology for the soil after application.

Is your share below the 50% target?

The organic matter in your slurry has not yet been sufficiently metabolised. It would be advisable to take measures for slurry treatment so that your slurry can cope as well as possible with the biology of your soil after spreading. Based on this finding, there is either a lack of lignin- or cellulose-degrading bacteria and fungi in your slurry or at least their activity is inhibited. This results in a lack of litter decomposition, which would also continue in the field. If you are already noticing that your soils are not breaking down the litter optimally, the reason for this could be that the slurry has not yet been optimally prepared.

15 Plant growth promoting bacteria

The right form of slurry treatment can strongly promote the bacterial plant growth promoting bacteria (PGPB). The rhizosphere is the region around the plant roots where most microbial activity takes place. This is where the growth-promoting and growth-inhibiting activities of microorganisms influence the growth and development of plants.

The plant growth-promoting rhizobacteria (PGPR) are very important due to their ability to help the plant in a variety of ways. The genera Pseudomonas, Bacillus, Azospirillum, Azotobacter, Arthrobacter, Achromobacter, Micrococcus, Enterobacter, Rhizobium, Agrobacterium, Pantoea and Serratia are well studied.

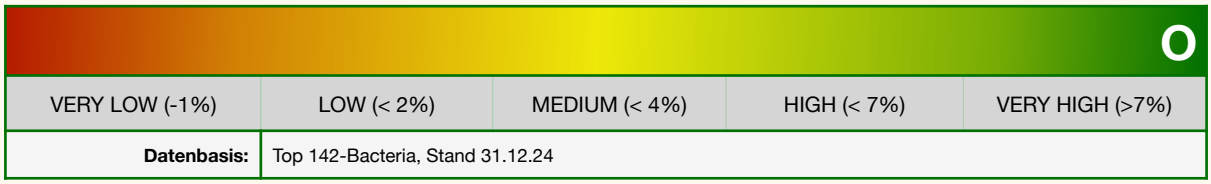
The rhizomicrobiome plays a crucial role in the uptake and assimilation of nutrients, the improvement of soil texture, the secretion and modulation of extracellular molecules such as hormones, secondary metabolites, antibiotics and various signalling substances, all of which lead to an improvement in plant growth and development.

The microbes and the compounds they secrete are valuable biostimulants and play a central role in regulating the stress responses of plants (Bhatt 2022).

There are a lot of plant growth-promoting bacteria in this slurry.

Actual value 8,0%

Plant Growth Promoting Bacteria (%)



Datenbasis:	Top 142-Bacteria, Stand 31.12.24

16 Phosphorous solubilility

Evaluation:
Bacterial pests / pathogens in the soil should not account for more than 1 % of the total number of bacteria. Proportions below this threshold can be interpreted as geogenic background contamination without pathological significance.

However, the higher the actual value is above the 1% threshold, the more likely it is that an increased pathogen pressure is present.

Actual value 4,98%

Phosphorous Solubility

VERY LOW (-0,5%)	LOW (< 1%)	MEDIUM (< 2%)	HIGH (< 4%)	VERY HIGH (>4%)
Datenbasis:	Top 124-Bacteria, Stand 31.12.24			

17 Pathogenic load

Bacterial pests / pathogens in the soil should not exceed 1% of the total number of bacteria. Proportions below this threshold value can be interpreted as geogenic background contamination without pathological significance.

However, the higher the actual value is above the 1% threshold, the more likely it is that increased pathogen pressure will be encountered.

Actual value 0,17%

Pathogens

VERY HIGH (>2,5%)	HIGH (< 2,5%)HIGH	MEDIUM (< 1,5%)	**LOW (< 1%)**	VERY LOW (-0,5%)
Datenbasis:	55 Pathogens, Stand 01.07.24			

Manure from cows often contains pathogenic strains of Streptococcus and Clostridia. These have a negative impact on soil biology (ZHANG 2023). However, this slurry is almost free of Streptococcus and without pathogenic Clostridia.

Pathogenic load

Pathogens in your slurry	PLOCHER	Reference
Flavobacterium	0,05 %	0,6 %
Streptococcus	0,04 %	
Staphylococcus	0,03 %	
Escherichia-Shigella	0,03 %	0,4 %
Succinivibrio	0 %	0,03 %
Bacteroides	0 %	0,03 %
Mycobacterium	0,02 %	
Gesamt	**0,17 %**	**1,06 %**
		No pathogenic load

18 Sulphur / methane in liquid manure as environmental indicators

Modern slurry treatment aims to condition the environment of the slurry in order to achieve the best possible compatibility with the soil biology near the surface after the slurry has been spread. Essentially, the aim is to harmonise the redox potentials of the slurry with those of the soil as well as possible. To achieve this, it is necessary to reduce excessive levels of methane or sulphur, as these would create an undesirably reduced environment, which would be unfavourable for soil biology.

The levels of sulphur-oxidising bacteria in the slurry are 0.01 %,
i.e. close to the detection limit. Elsewhere in this report, however, we found very high concentrations of vitamin B12 in the slurry. In addition to high levels of iron and molybdenum, these also require high levels of sulphur so that vitamin B12 can be formed by nitrogenase. This means that the high sulphur contents, as exemplified by the vitamin B12 level, have been bound microbially and the free residual sulphur content will be very low, as there are hardly any sulphur-oxidising bacteria present.

The situation is similar with methane-oxidising bacteria. The table below clearly shows that methane-oxidising processes no longer take place. There are ‘oligotrophic’, i.e. nutrient-poor conditions - methane is virtually no longer present.

Methane-oxidizing bacteria (MOB)

Genus	Target share	Cow slurry Plocher
Eutrophic conditions with the highest rate of CH4		
Methylobacter	63 %	0,00 %
Methylomonas	30 %	0,03 %
Methylocystis	1 %	0,00 %
Methylococcus	2 %	0,01 %
Methylocaldum	1 %	0,01 %
Transitional conditions		
Methylobacter	27 %	0,00 %
Methylomonas	21 %	0,03 %
Methylococcus	44 %	0,01 %
Methylocystis	4 %	0,00 %
Oligotrophic conditions with the lowest rate of CH4		
Methylobacter	3 %	0,00 %
Methylococcus	26 %	0,01 %

19 Favourable values for methane, sulphur, iron, hydrogen sulphide

Untreated slurry provides a highly reducing environment in which the cycles of iron, methane, sulphur and hydrogen sulphide play a significant role. However, this reduced environment is hardly suitable for use on oxidised agricultural land.

For this reason, we are examining at this point how the proportions of these substances are to be assessed in terms of suitability for agriculture.

a) **Methane producer**

High methane levels are characterised by the group of methane-oxidising bacteria (MOB). High proportions with many species indicate significant methane metabolism, low proportions with few species indicate a subordinate significance of the methane content (CHAUHAN 2012). The present sample shows hardly any methane formation.

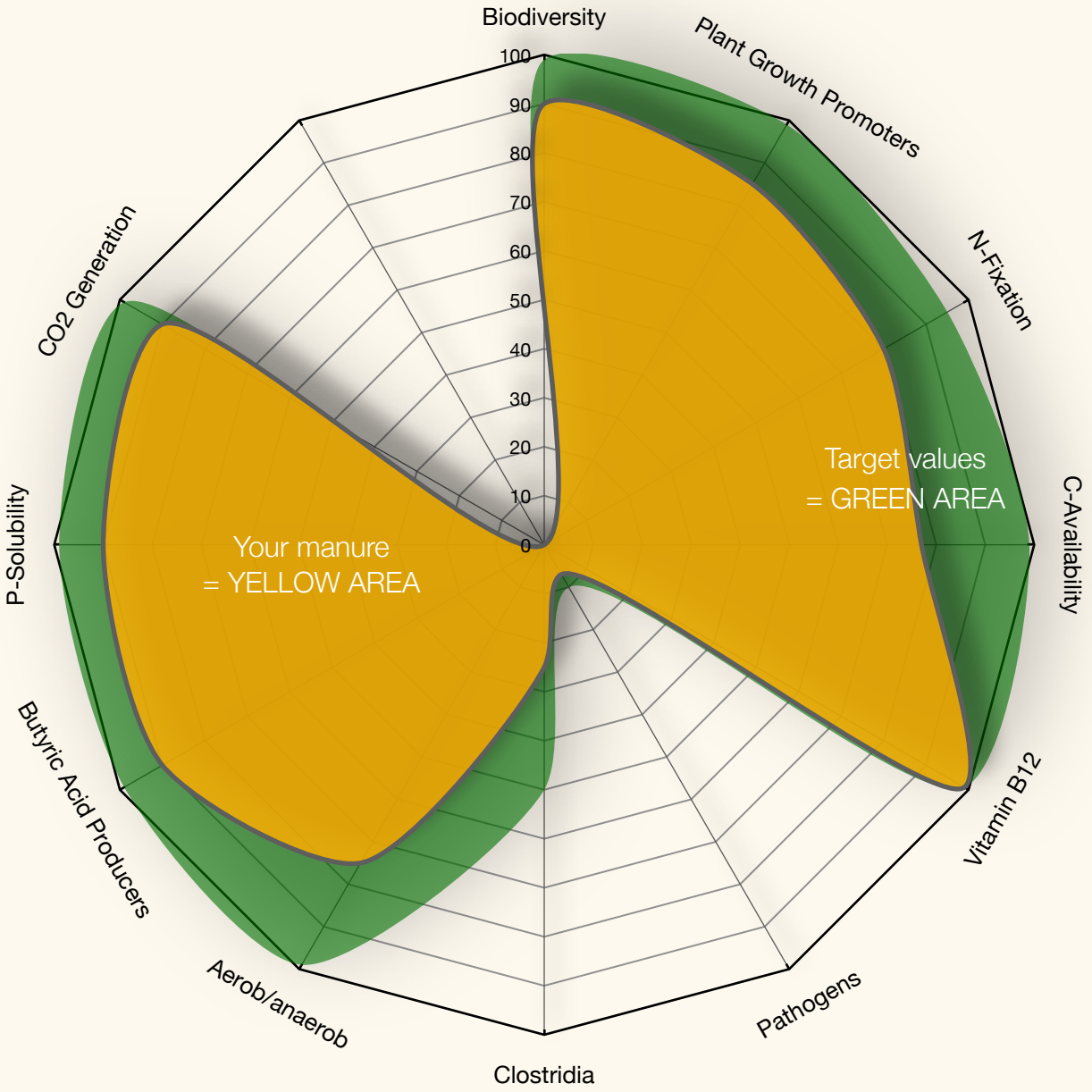
b) **Special group Halobacterota (methane producers)**

The Halobacterota are a special methane-forming group with sulphate reduction. They only make up 0.4% of your slurry sample and are therefore of no significance. A value of 0.5% should not be exceeded. This low value also shows that there is no increased salt content in your slurry. This group of Halobacterota would undesirably convert CO2 into methane, but this does not occur here.

c) **Sulfur producer**

The sum of sulphur-oxidising and sulphur-reducing bacteria in their sample is so low that the data is close to the detection limit.
The values in detail are
SOB sulphur oxidisers 0.01% SRB sulphur reducers 0.22% No active sulphur processing is evident, but high amounts of sulphur are already bacterially bound in the nitrogen-fixing and vitamin B12-forming bacteria.

20 Biological slurry index (BSI) on the status of your slurry treatment



Your biological slurry index (BGI) clearly shows the highs and lows of your sample in relation to an agricultural application. The yellow areas contain your data.
You get a direct comparison with target values as reference data (green areas).

Conclusion: Your biological soil status is excellent in the soil functions shown. Nutrients are available in a readily soluble form, and the high content of humic substances also contributes to this.

For the correctness
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Laboratory Manager Mikrobiom-Lab GmbH

Oberthulba, 12.02.2025

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