Mitigation of ammonia emissions by acidification of organic fertilizers

WP 4
First results of field trials in Germany

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In-field acidification

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- Trials on micro plot scale in grassland and winter wheat

Photos: Dr. Frank Steinmann, LLUR

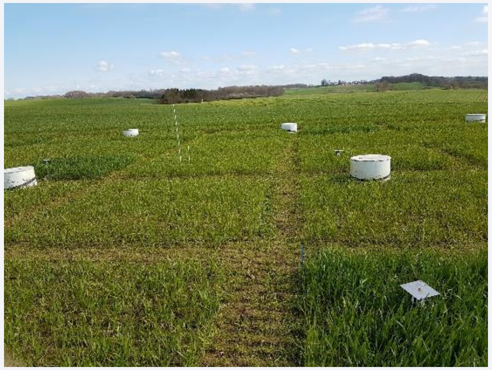
Field trials on Grassland and Wheat

Material and Methods

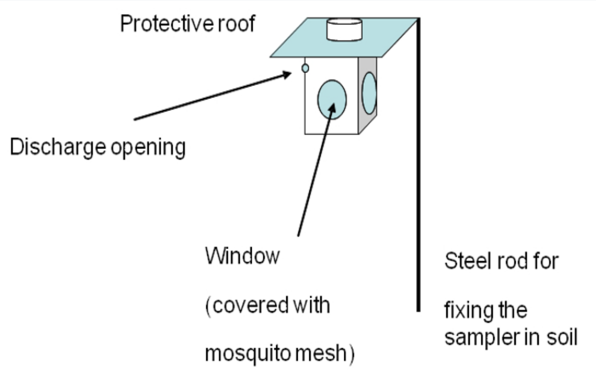
Trial site 2017: Grönwohld
- Grassland (0.44 ha) und Wheat (0.2 ha)
- Randomized Block experiment

Measuring program:

- Yield sampling by hand
  - Grassland: 5 silage cuts
  - Wheat: whole plant silage cut and threshing cut



- NH_3-Emissions (daily, several times a day after fertilization up to 7 days)
  - Passive samplers und Dräger-Tube Method (Pacholski, 2006)
- N_2O-Emissions (weekly 365 d, daily after fertilization):
  - „closed-chamber“ (Hutchinston und Moisier, 1981)



Field trials on Grassland and Wheat

Material and Methods

Grassland	Wheat
Digestate	Digestate
Digestate H_2SO_4	Digestate H_2SO_4
CAN	CAN
Urea	Control
Urea stabilized	
Control	

- Mineral-N based
- Digestates (pH-value: 8,7)
- Acidification immediately before application to pH 5,5 – 6 with H_2SO_4
- „trailing hose application“ with watering cans
- Additional PK**S**-fertilization after each N-fertilization

Field trials on Grassland and Wheat

Material and Methods

- Grassland:

	Fertilizations
360 kg N/ha	120/100/100/40
240 kg N/ha	90/60/60/30 ← NH_3 measurements
120 kg N/ha	60/40/20/0

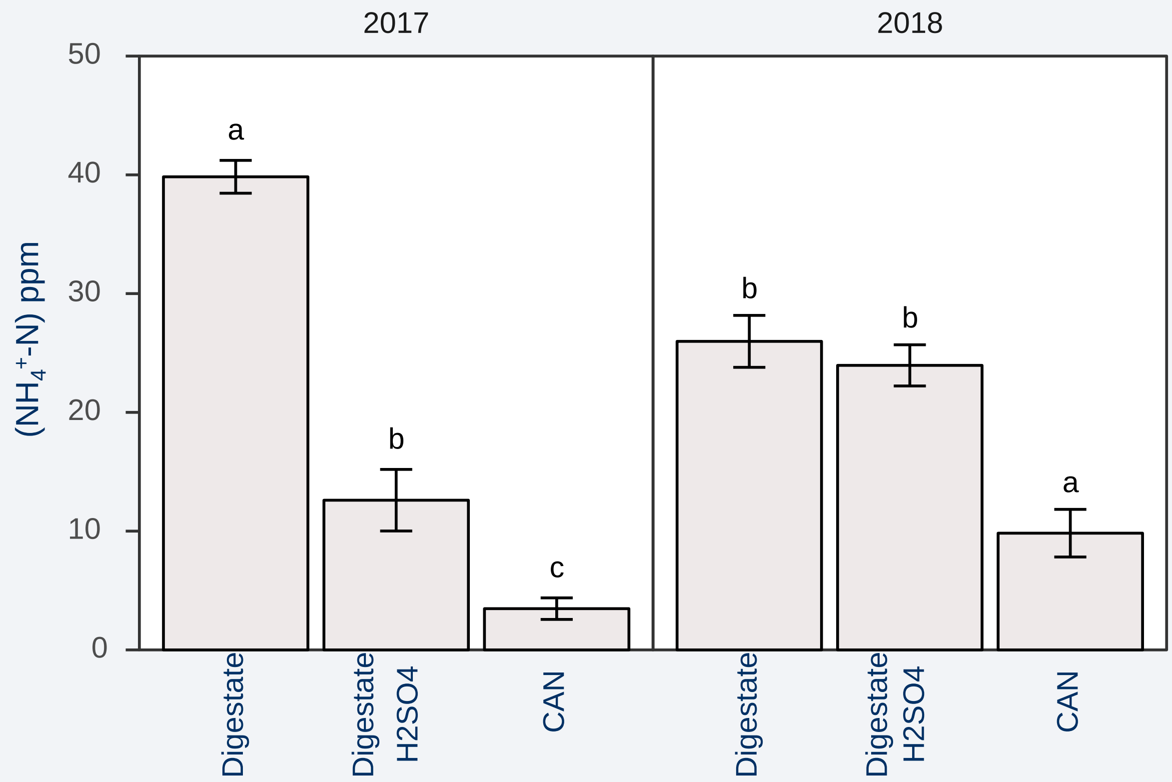
- Wheat:

	Fertilizations
300 kg N/ha	100/100/100
200 kg N/ha	100/50/50 ← NH_3 measurements
100 kg N/ha	50/50/0

Preliminary results winter wheat 17/18

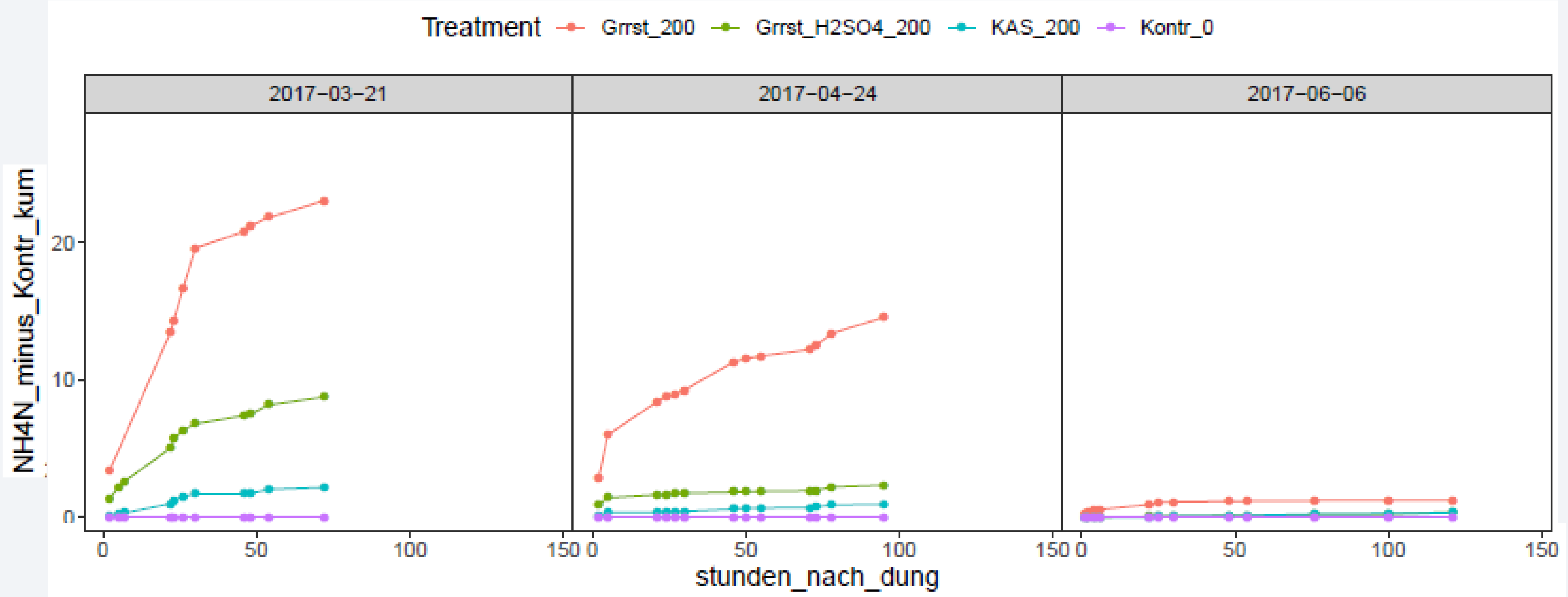
Ammonia emissions

- Cumulated by passive samplers (minus CT)
- 3 fertilizations
- 2017: reduction potential due to acidification approximately 68%
- 2018: reduction potential due to acidification approximately 8%
- technical problems during the first dressing in 2018
  - ➢ No emission reduction could be observed



Measured cumulated ammonia emissions by acid traps expressed as ppm (NH4-N) over three fertilizations in each trial year 2017 and 2018. (differences in letters indicated differences between treatments)

Preliminary results winter wheat 2017

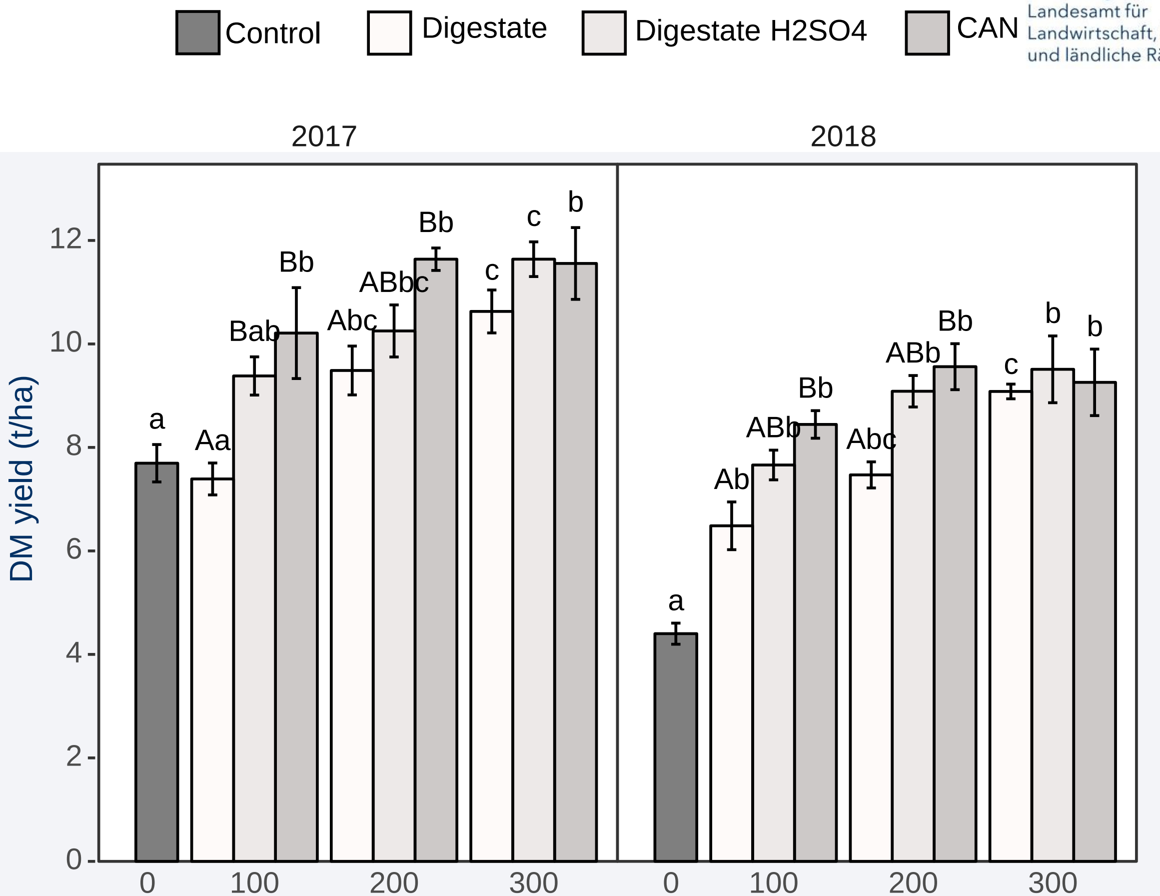


Examples for the course of ammonia emissions of the different tested treatments in hours after application (illustrated are three application events in winter wheat 2017).

Preliminary results winter wheat 17/18

Kernel DM-yields

- Significant differences between acidified treatments and non-acidified treatments could be observed at the lowest N-rate (100 kg N/ ha) in 2017.
- "Digestate 100 H2SO4" reached kernel yields of 9,38 t/ha, which is an additional yield of nearly 2 t/ha due to acidification in comparison to "Digestate 100" (7,39 t/ha) in 2017.
- comparing the acidified digestates and mineral fertilizer it is noticeable that the additional yield of CAN treatments at N-rates of 100 and 200 kg N/ha was not significant.



Kernel DM yields of the different treatments in 2017 and 2018. Sampling was conducted on 03.08.2017 and on 26.07.2018. (Different lowercase letters indicated significant differences between the different N-rates, different capital letters indicated differences between different nitrogen fertilizers)

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Preliminary results permanent grassland 17/18

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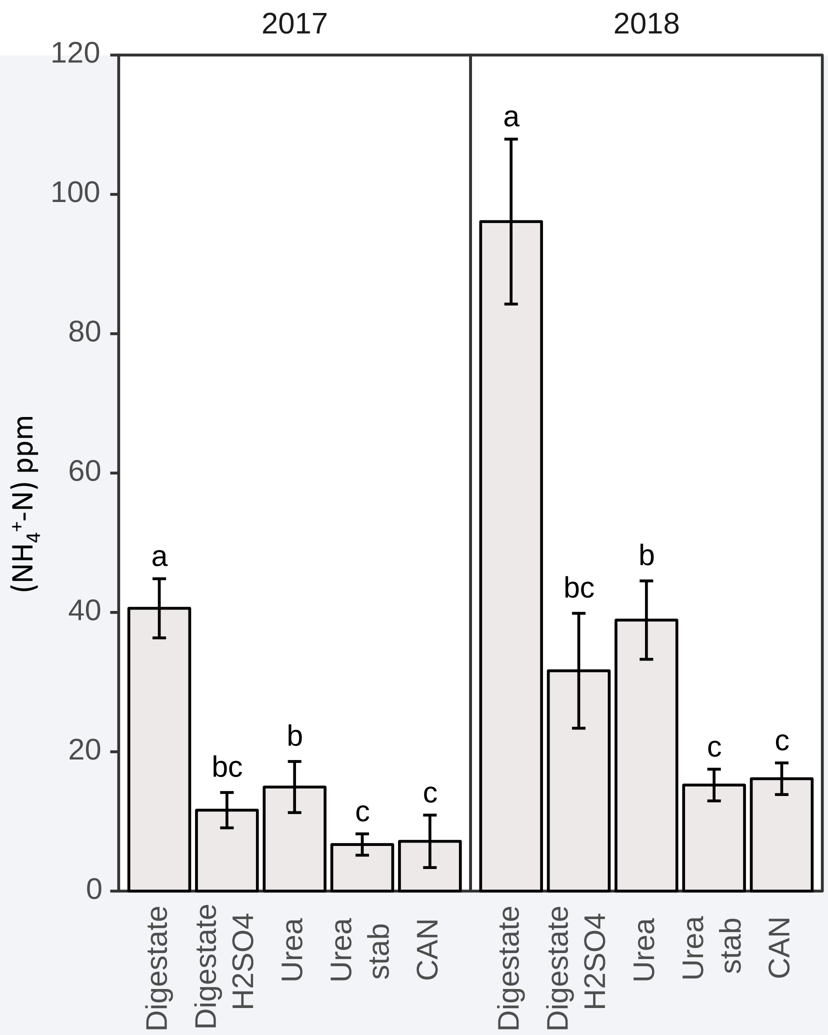
Ammonia emissions

- Cumulated by passive samplers (minus CT)
- 4 fertilizations

- 2017: Reduction potential due to acidification approximately 71 %
- 2018: Reduction potential due to acidification approximately 67 %

- Reduced emissions of stabilized Urea in comparison to the non stabilized treatment



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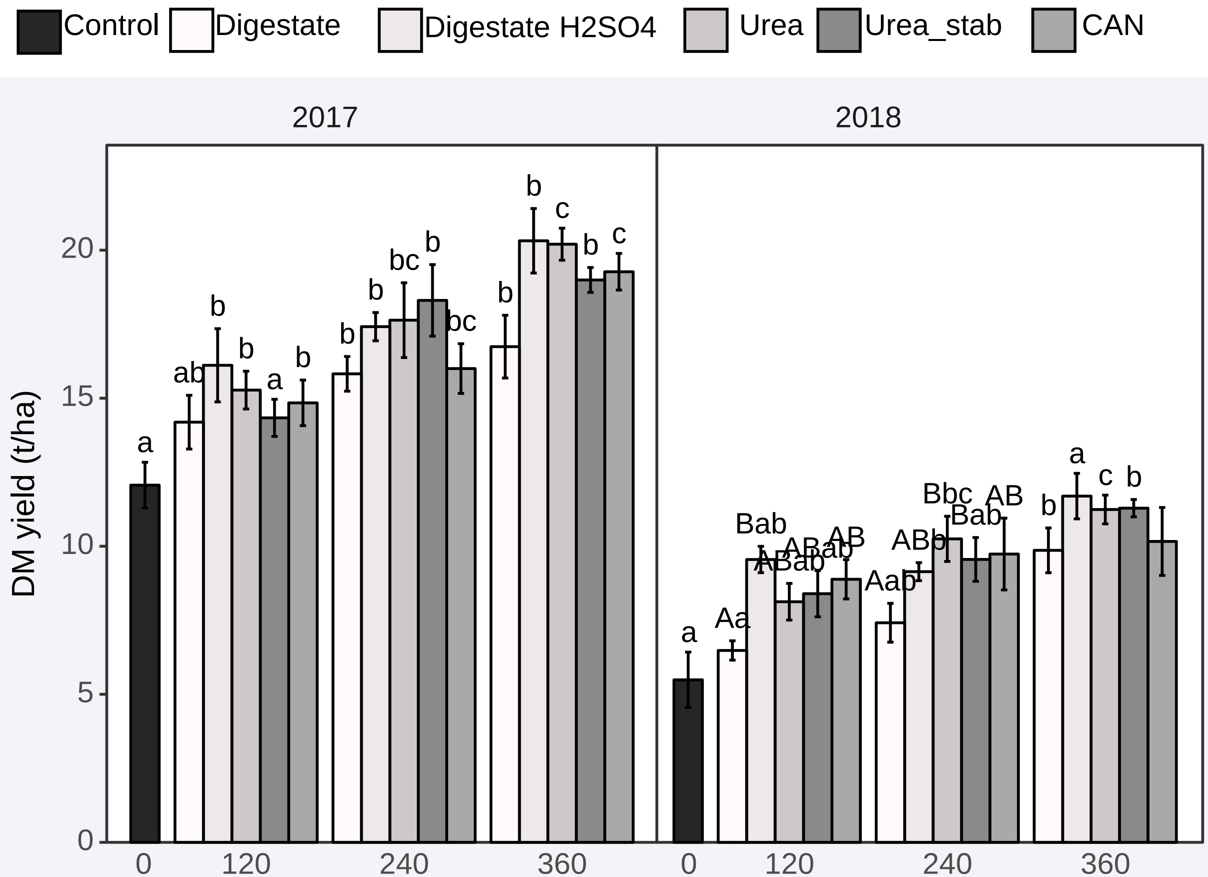
DM-yields

- 2017: 5 silage cuts
  - ➢ No significant differences between fertilizers
  - ➢ Acidification of digestates lead to higher yields (not significant) at each N-rate in comparison to non-acidified digestates

- 2018: smaller yields due to heavy droughts, no 3rd cut
- Significant higher yields due to acidification in comparison to non acidified digestates on 120 N-rate



DM-yields of all different treatments in 2017 and 2018. 5 silage cuts, 2017; 4 silage cuts, 2018 (Different lowercase letters indicated significant differences between the different N-rates, different capital letters indicated differences between different fertilizer treatments).

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Material and Methods – pilot farms

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Work Package 3: Pilot Farms 5 trial locations in Schleswig Holstein 2017

Location	Crops	
Rendswühren	Triticale	Grassland
Bredeneek	Grassland	
Ascheberg	Wheat	Grassland
Bellin	Wheat	
Selent	Maize	

- Acidification of digestates to the first fertilization with 4 l H_2SO_4/m³
- Mineral supplementation to following fertilizations
- Yield sampling, ears/m², thousand kernel weight
- Track: ~ 180 m , ~ 60 m per treatment
- 3 samplings (0,5 m²) per treatment by hand

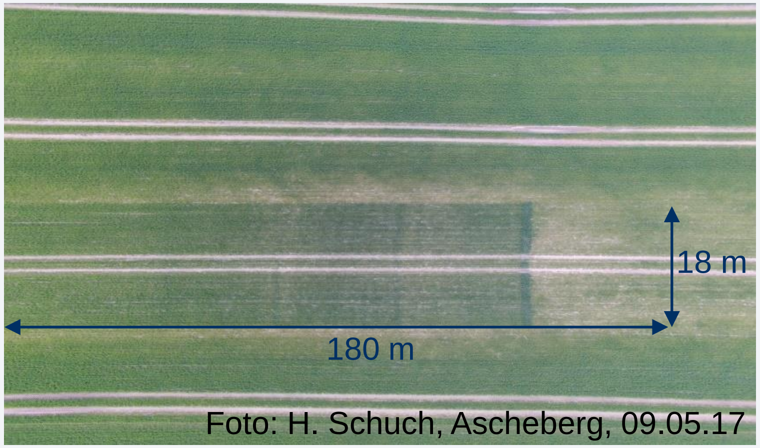

Foto: H. Schuch, Ascheberg, 09.05.17

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Preliminary results– pilot farms

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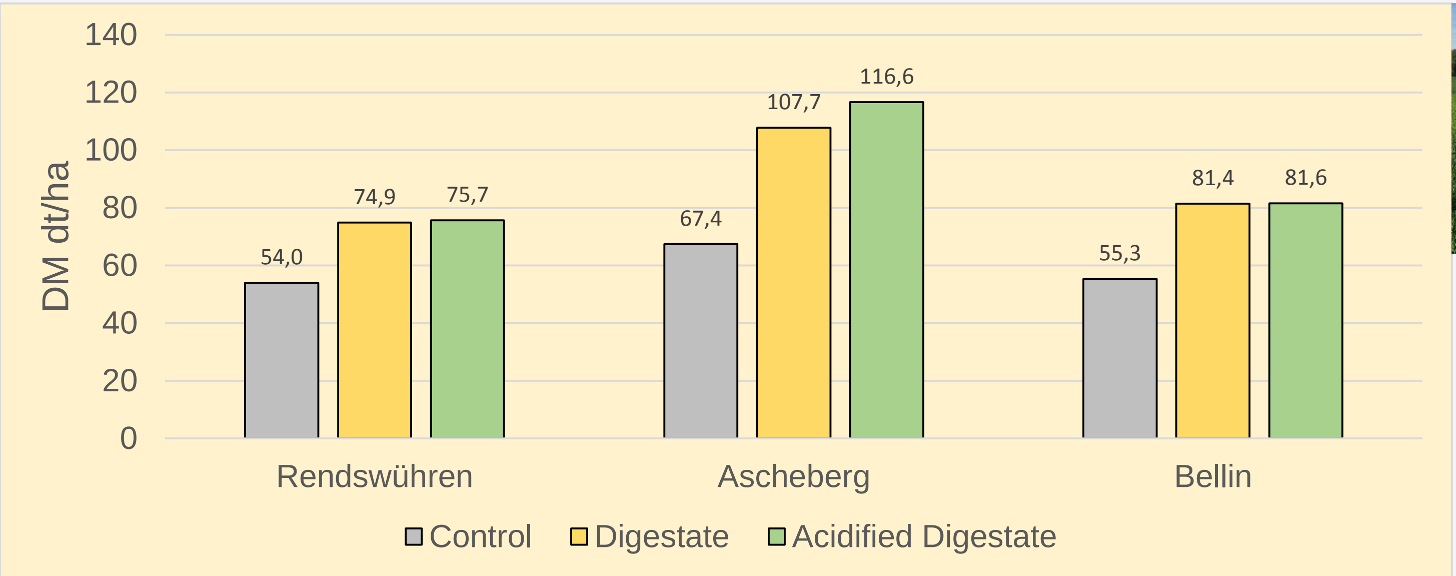
Pilot Farms: Kernel DM Yield (dt/ha)



Location	N total (kg/ha)	07.04.17
Rendswühren (Triticale)	180 (90/90)	90 kg NH4-N/ha (Nmin included) 27 m³/ha digestates
Ascheberg (Wheat)	180 (110/70)	110 kg NH4-N/ha (Nmin included) 29 m³/ha digestates
Bellin (Wheat)	190 (100/50/40)	100 kg NH4-N/ha (Nmin included) 38 m³/ha digestates

First conclusions

Field trials:

- Lowering the pH to 5,5-6 significantly reduced ammonia emissions.

- Significance of yield advantages in relationship to N-rate and year.

  - Acidification resulted in higher or similar yields compared to fertilization with non-acidified digestate, especially at low N level/ N-supply.
  - Additional plant available nitrogen especially increased yield at lower N level.

- On grassland, nitrous oxide emissions of the acidified treatments were slightly higher in comparison with the non-acidified treatments.

- In winter wheat the acidified treatments showed slightly lower N_2O emissions.

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EU STRATEGY FOR THE BALTIC SEA REGION FLAGSHIP

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Thank you for your attention!

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Photo: Dr. Frank Steinmann, LLUR