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Evaluation of liquid digestate for organic cultivation of field vegetables

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Evaluation of liquid digestate for organic cultivation of field vegetables

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Introduction



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Introduction

Background:

- > Alternative sales opportunities liquid digestate are sought
- > Vegetable crops have relatively high nutrient requirements
- > Commercial fertilizers authorized for organic production are expensive

Question:

- > Can liquid digestate from industrial anaerobic fermentation plants offer an alternative to commercial fertilizers in organic vegetable production ?

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Approach



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Approach: crop

- > Experimental field of the company „Rathgeb Bioprodukte AG“ in ZH-Alten (medium-heavy brown earth)
- > Cultural data:

<u>Crop</u>			
Celery variety:	Alicia F1 (Bejo)		
<u>Field preparation</u>			
Soil tillage:	company usual	Basic fertilization:	none
<u>Crop management</u>			
Date of plantation	CW 19	Plantation distance	40 x 60 cm
Irrigation	as needed	Weeds management	company usual
Date of harvest	19.9.2017		

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Approach: fertilization treatments

- > A basic need of 180 kg N/ha for knob celery was assumed.
- > Liquid digestate from an industrial anaerobic fermentation plant (type Kompogas) from SwissFarmerPower Inwil AG (filtrate from swing sieve 0,166 mm).

Reference fertilization:

- > Feather meal (12 N_{tot}% bzw. 8.4 % N_{avail} „Biorga Stickstoffdünger, Hautert)
- > chicken manure (3.5% N, 4% P₂O₅, 2% K₂O, Vivasol)
- > Patentkali (30% K₂O und 6% Mg)



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Approach: characterization of the liquid digestate

Dry matter DM	% FM	9.6	Spezifisches Gewicht	kg/l	1.0
loss on ignition 500°C (DM)	% DM	53.5	Kohlenstoff Corg	g/kg DM	310.1
pH value		8.1	C/N-Verhältnis		5.7
N _{tot} (according to Kjeldahl)	g/kg DM	54.3	Gesamt-N (acc. to Kjeldahl)	kg/m ³	5.2
NH ₄ -N	g/kg DM	23.2	NH ₄ -N	kg/m ³	2.2
NO ₃ -N	g/kg DM	0.05	NO ₃ -N	kg/m ³	0.005
N _{org}	g/kg DM	23.2	N _{org}	kg/m ³	2.2
P ₂ O ₅	g/kg DM	24.1	P ₂ O ₅	kg/m ³	2.3
K ₂ O	g/kg DM	43.4	K ₂ O	kg/m ³	4.2
Calcium	g/kg DM	29.0	Calcium	kg/m ³	2.8
Magnesium	g/kg DM	8.0	Magnesium	kg/m ³	0.8
Sulfur	g/kg DM	4.4	Sulfur	kg/m ³	0.4



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Approach: trial design

- > Per treatment 4 repetitions à 14,4 m² each
- > Treatments:

Treatments	1 st fertilization 18.05.2017		2 nd fertilization 09.06.2017		3 rd fertilization 02.07.2014	
	per ha	per repetition	per ha	per repetition	per ha	per repetition
Treatment 1	-	-	56 m ³	84 liters	-	-
Treatment 2	29 m ³	42 liters	29 m ³	42 liters	-	-
Treatment 3	19,3 m ³	28 liters	19,3 m ³	28 liters	19,3 m ³	28 liters
Treatment 4	C ¹ : 1750 kg P ¹ : 883 kg	C ¹ : 2,52 kg P ¹ : 1,17 kg	B ¹ : 1414 kg	B ¹ : 2,04 kg	-	-
Treatment 5	-	-	-	-	-	-

¹C: chicken manure, P: Patentkali, B: Biorga N



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Approach: sampling

- > Soil sampling and application of liquid digestate



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Results



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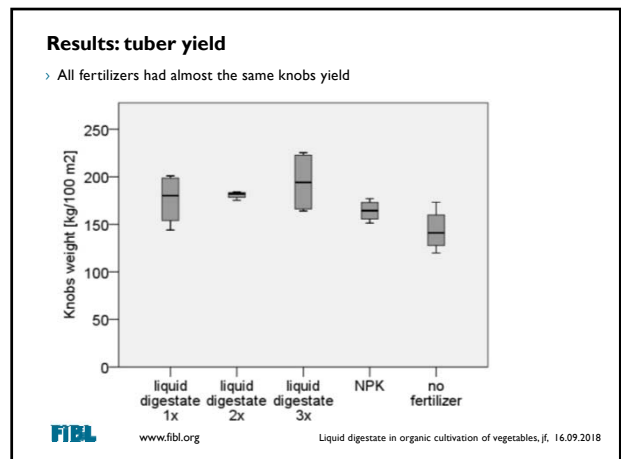
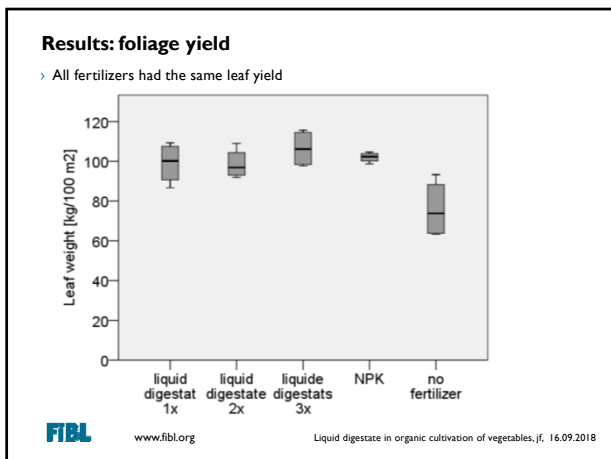
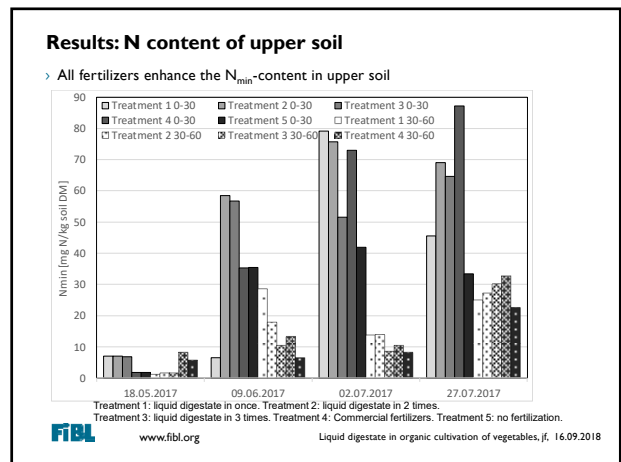
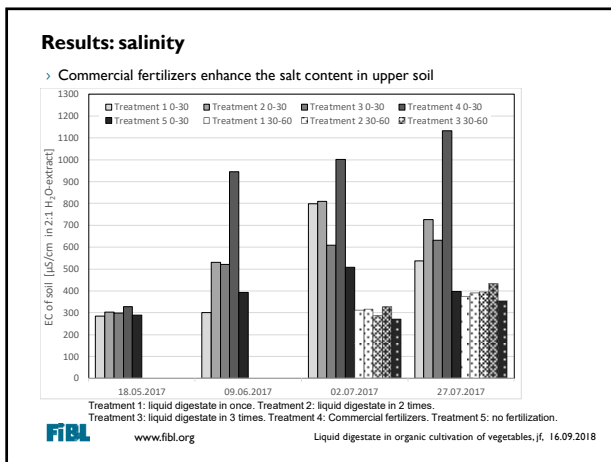
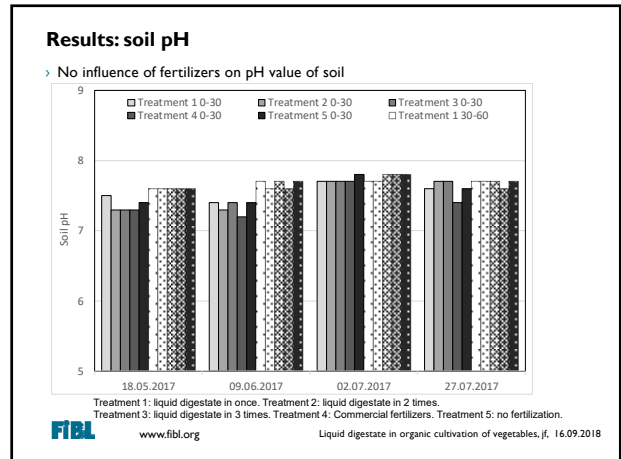
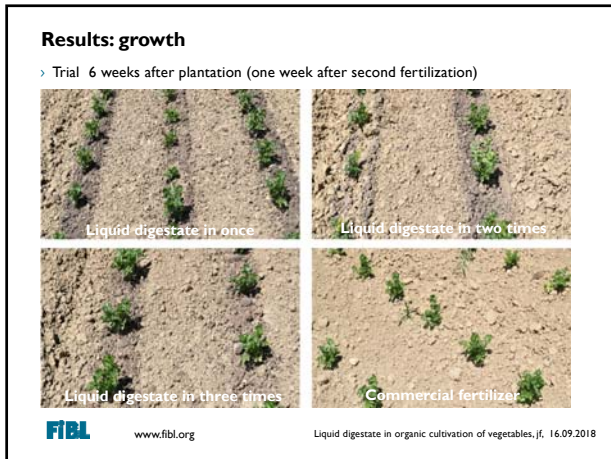
Results: observations

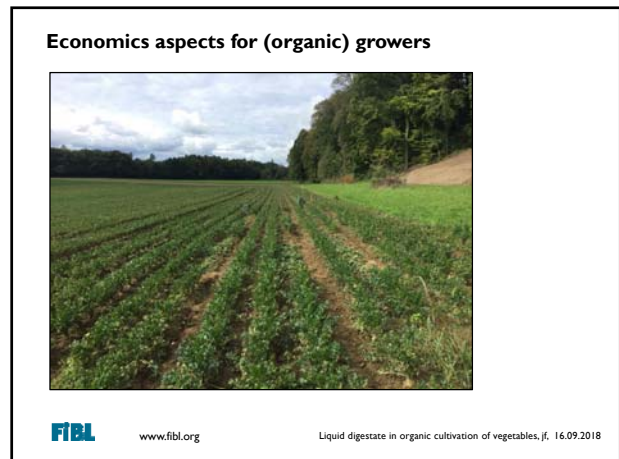
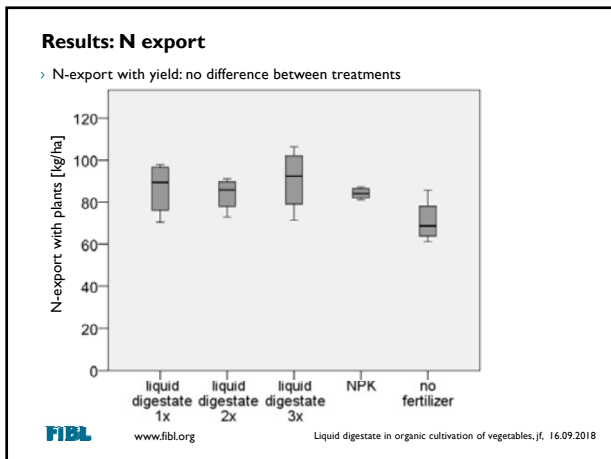
- > During application, liquid digestate is well trickled away, except in the treatment where the total amount of liquid digestate is applied at once.
- > No quality differences between the knobs of the different treatments could be observed.



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Economics aspect: assumptions

- > Fertilizer costs for liquid digestate: 0 (delivery to field edge for free) resp. 12 CHF (≈ 10 €) (cost of transport to field edge) per m³
- > Cost for application of liquid digestate: 7 CHF (≈ 5.80 €) per m³
- > Fertilizer costs for commercial fertilizers: market price
- > Cost for application of commercial fertilizers 91 CHF (≈ 75.80 €) per passage (calculation with „ProfiCost Gemüse“ from SZG / VSGP)

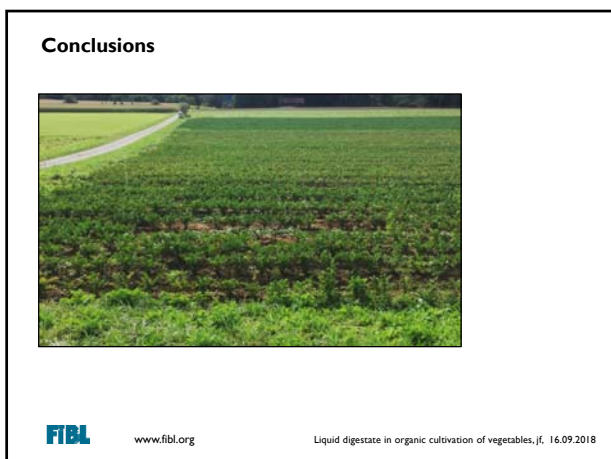
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Economics aspect: fertilization costs

Fertilizer	Application quantity per ha pro ha in t resp. m ³	Fertilizer price per t resp. m ³ in CHF (€)	Application costs per ha in CHF (€)	Fertilizer costs per ha incl. application in CHF (€)	Average yield in t per ha	Fertilizer costs per ton knob celery in CHF (€)
Liquid digestate	60	0	420 (350)	420 (350)	18.4	23 (19.15)
	60	5 (4.15)	420 (350)	720 (600)	18.4	39 (32.50)
>Commercial fertilizer in trial						
chicken manure	1.75	579 (482.5)	91 (75.80)	1104 (920)		
patenkalik	0.003	540.5 (300.3)	91 (75.80)	500 (473.3)		
leather meal	1.414	1060 (883.3)	182 (151.65)	1681 (1400.8)		
total			291.4 (242.85)	3353 (2794.2)	16.4	204 (170)
Biorga Cuma ¹	2.2	830 (691.65)	273 (227.5)	2099 (1749.2)	18.4 ²	114 ² (95) ²
Ammonium nitrate (conv. production)	0.58	379 (315.8)	273 (227.5)	436 (363.3)		

¹ P and K are often not fertilized in organic crop. Usually, Biorga Cuma (leather flour) is applied in field vegetables, so this fertilizer is cheaper than leather meal. It will usually apply in 3 applications.
² Calculation with assumption, that knobs yield is the same than with liquid digestate

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Conclusions

- > The tuber yield with liquid digestate was at least as good as with organic commercial fertilizers.
- > The composition of nutrients in liquid digestate corresponded relatively well to the need of the crop, whereby the phosphor amount was slightly elevated (important, because it could be a limiting factor with Suisse Bilan).
- > From a financial point of view, fertilization with liquid digestate is clearly advantageous than organic commercial fertilizers (even when the higher costs for application of liquid digestate are considered).
- > No negative impact of liquid digestate on soil or plants could be observed.
- > Recommendation: if fertilization only with liquid digestate, at least two applications should be made (max. approx. 30 m³ per ha and application). Otherwise, infiltration of the liquid digestate could occur.

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