

# Development of a new technology for the production of plant fertilizers from the fermentation residues of a biogas plant - digestate and wood chip cogeneration residues - wood ash

Latvia University of Life Sciences and Technologies; JSC «JP Ziedi»; LLC «Pampāļi»; LSFRI «Silava»; ZS «Irbenes»; LLC «Fortum Latvia»; LLC «Dobeles Eko»; LLC «Latvi Dan Agro»; ZS «Līgo»

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NATIONAL  
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# Short rotation forests (SRF) on marginal lands



Cutaway peatland with no applied fertilizers three years after planting poplar cuttings. \*1., \*\*2.

By resolving the problem of nutrient deficiencies, marginal areas can be made suitable for SRF

## The effect of wood ash application on growth, leaf morphological and physiological traits of trees planted in a cutaway peatland

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Cutaway peatland three years after fertilizing with 5/t ha wood ash and planting poplar cuttings.

\*1.,\*\*2.



Cutaway peatland three years after fertilizing with 15/t ha wood ash and planting poplar cuttings.

\*1.,\*\*2.

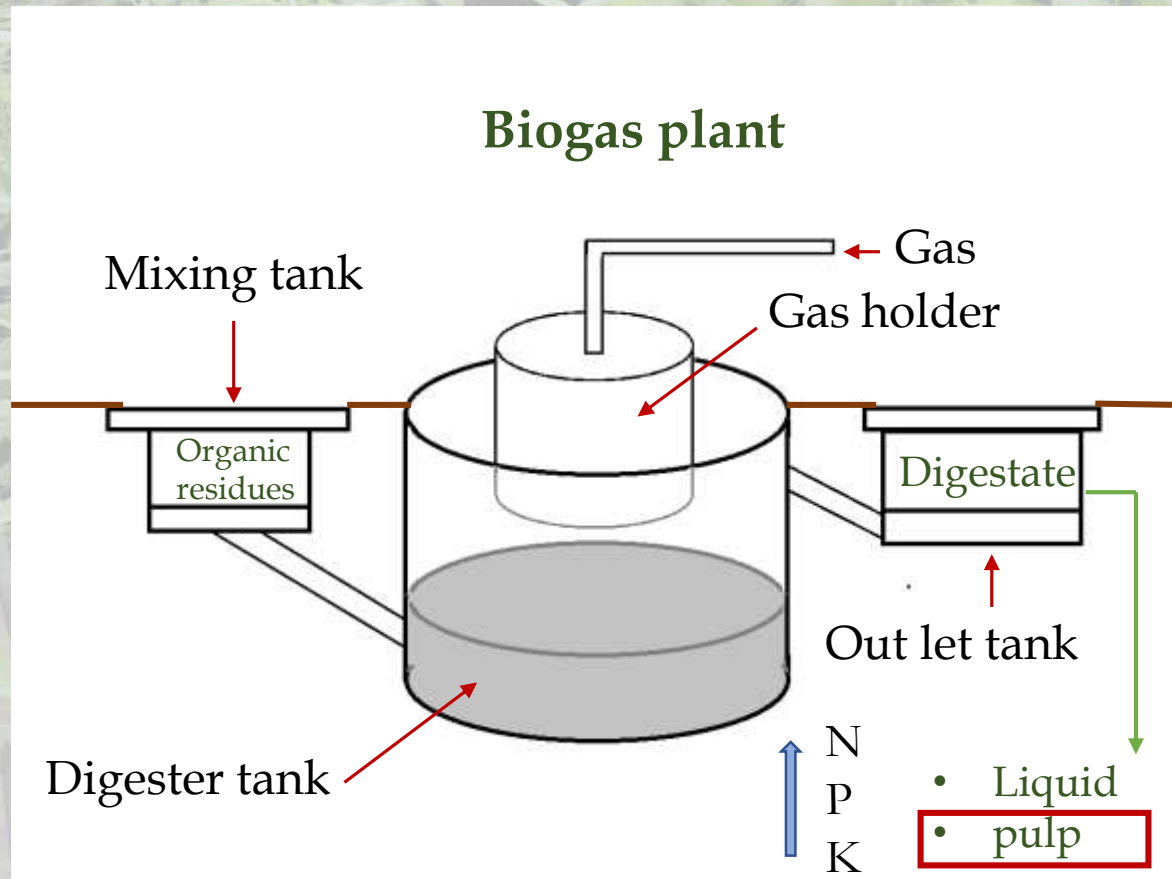
Wood ash fertilizer played an important role in the survival of poplar cuttings on cut-away peatland

↑ pH    ↑ K    ↑ P

\*1. "Sustainable and responsible management and re-use of degraded peatlands in Latvia" (LIFE14 CCM/LV/001103)

\*\*2. "Marginal lands for Growing Industrial Crops" (agreement No 727698)

# Biogas plant digestate



2020.

Poplar clones:

**Auce** ( in Latvia selected clone)

**OP42** (syn.Hybride 275)

Substrate:

Forest soil (↓ P, K ; pH = **4.3**)

Biogas digestate : wood ash

| Cattle | 1:1 | 1:2 | 1:3 | 1:4 | 2:1 | 3:1 | 4:1 | ctrl |
|--------|-----|-----|-----|-----|-----|-----|-----|------|
| Pigs   | 1:1 | 1:2 | 1:3 | 1:4 | 2:1 | 3:1 | 4:1 | ctrl |

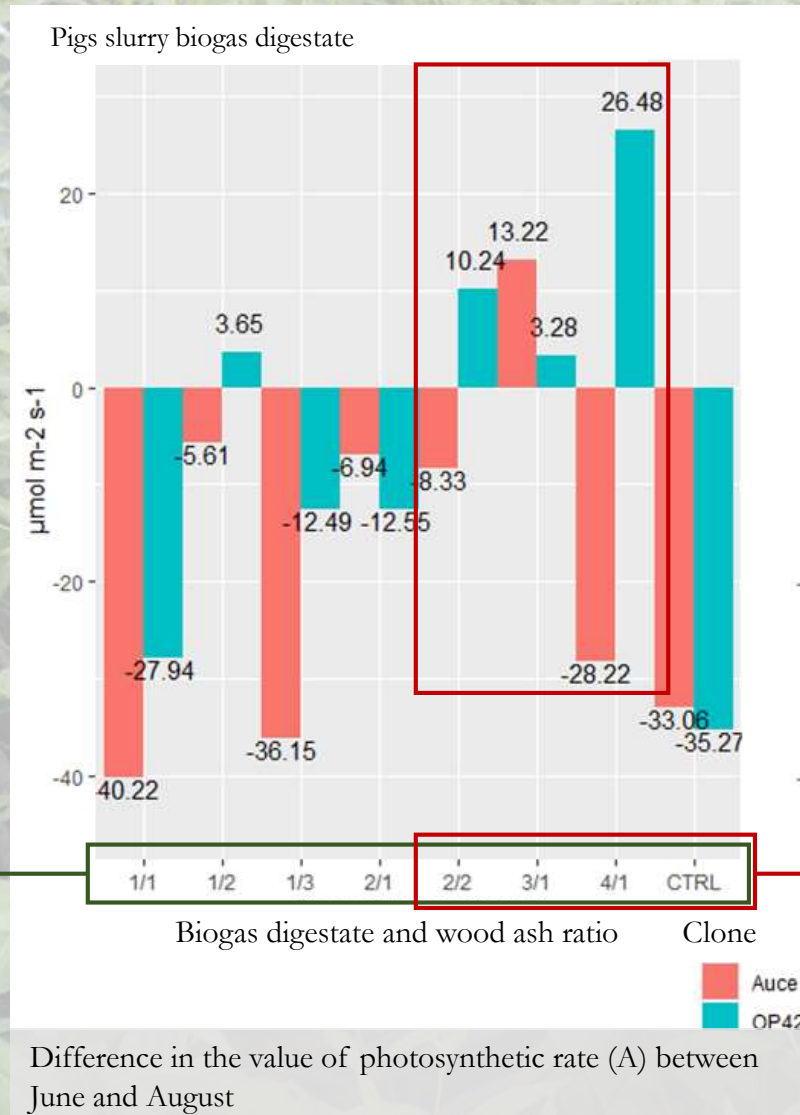
1 dose = 3 t/ha



2021.



# Results from first year



2020.

2021.

Photosynthetic rate was higher for fertilizer with higher biogas digestate dose compared to wood ash dose or control group

Photosynthetic activity lasted longer for fertilized groups, especially for op42 clone

**1. Does higher photosynthetic rate and longer photosynthetic activity indicate higher biomass values?**

**2. Is there significant difference between biogas digestate type?**

# Morphological Traits



Soil samples were taken from each variant



Roots were scanned in the control and 4:1 biogas digestate:wood ash group



Total number of leaves,  
fresh and dry mass and  
specific leaf area (SLA)



Shoot and root height,  
fresh and dry mass

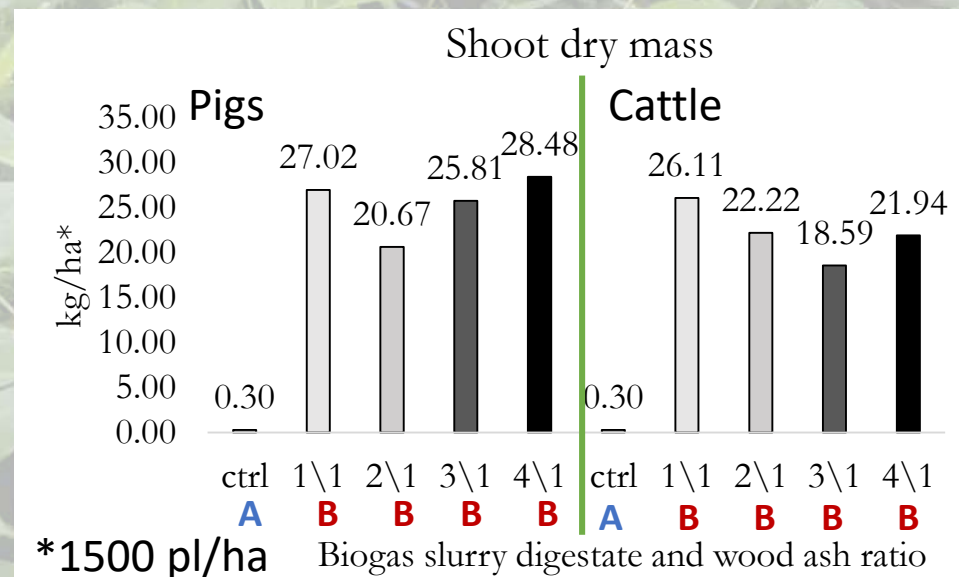
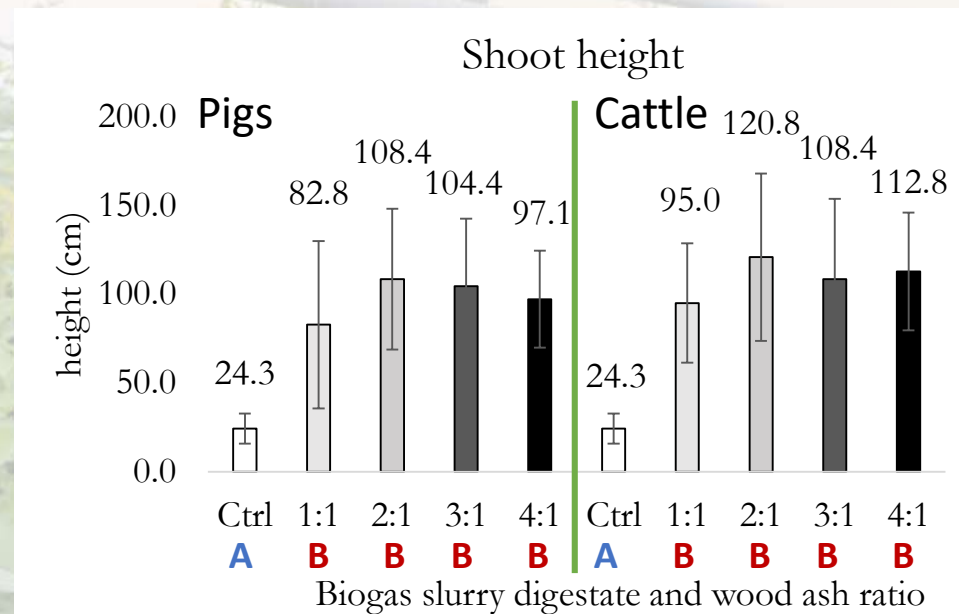
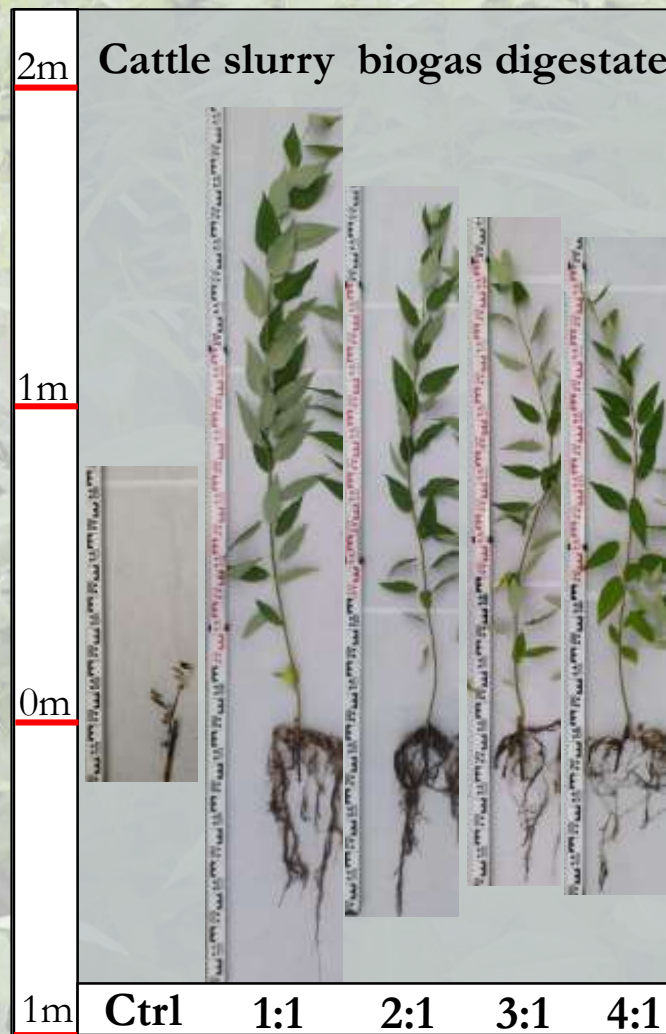
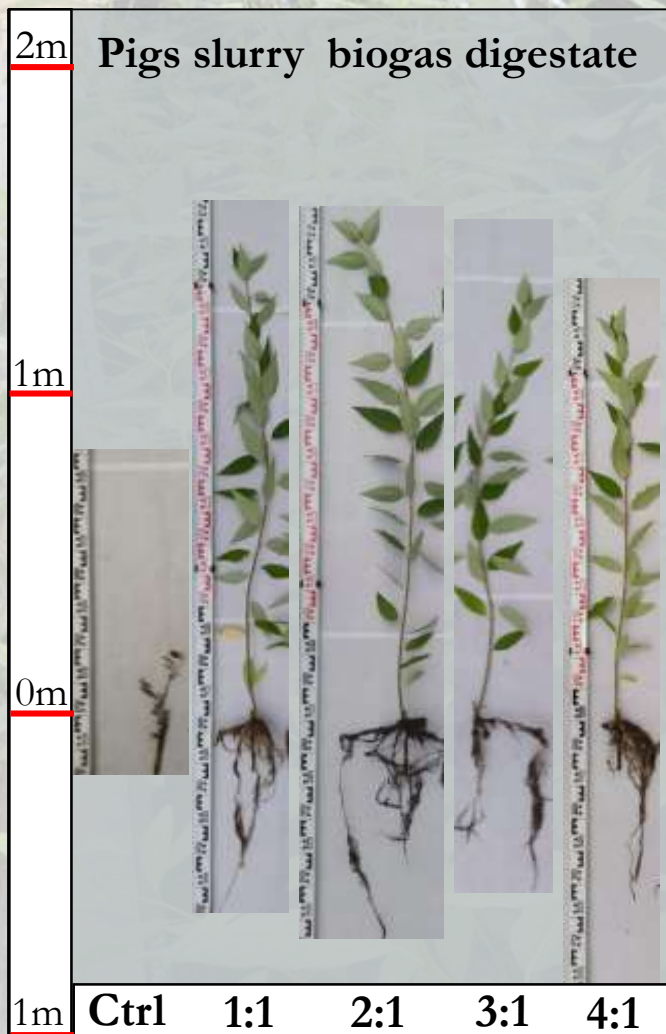


Photosynthetic rate  
measurements using portable  
photosynthesis system

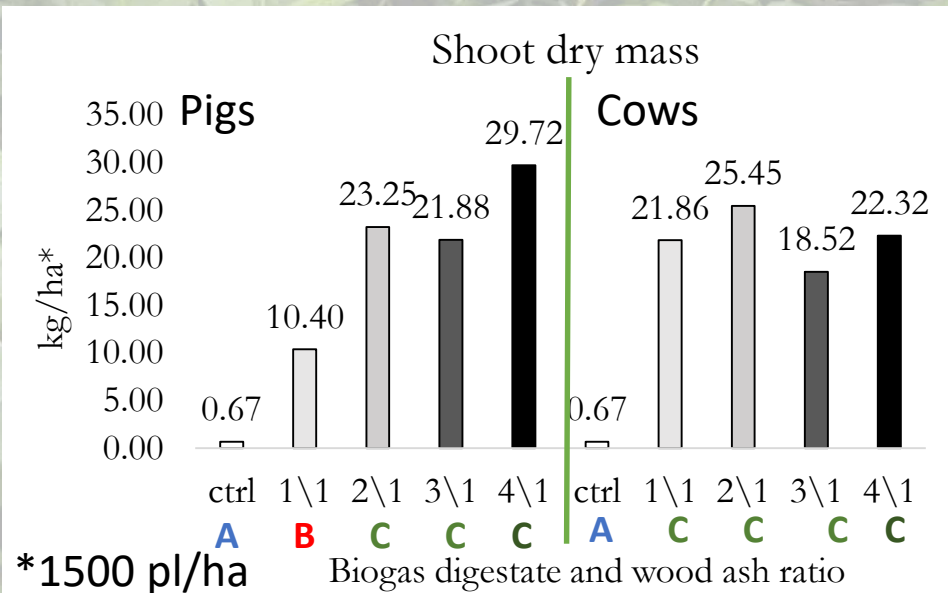
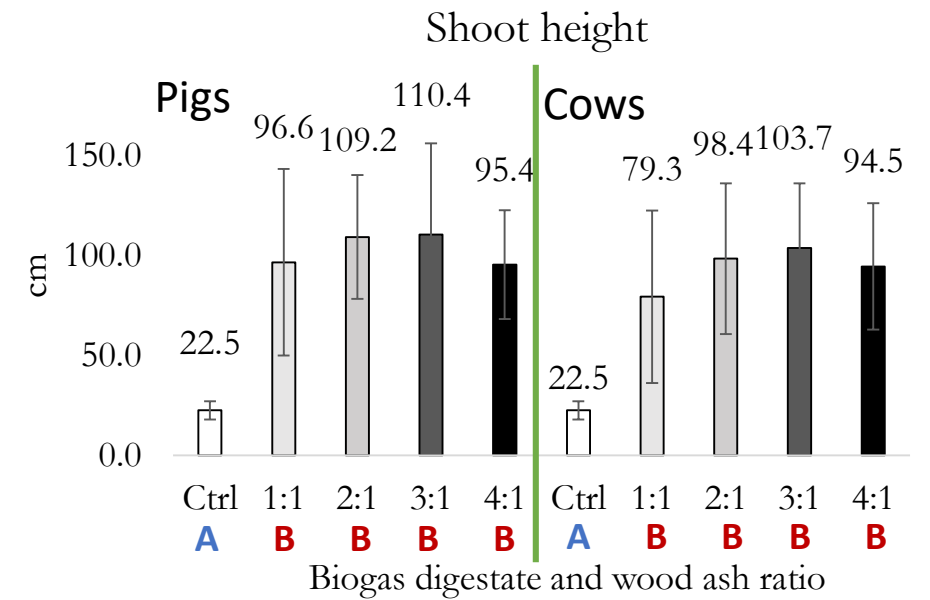
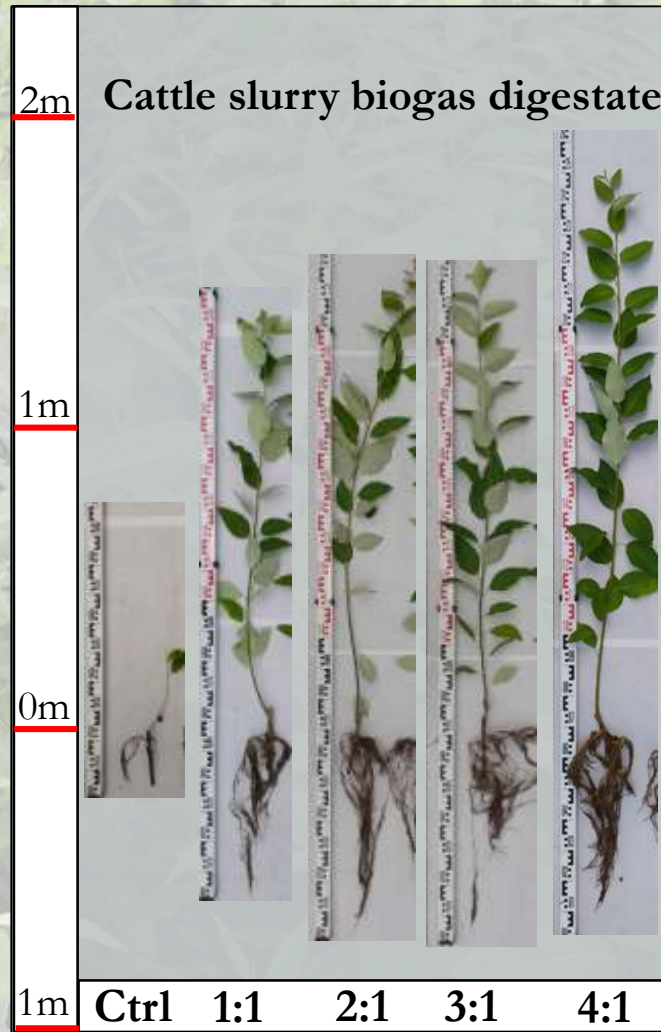
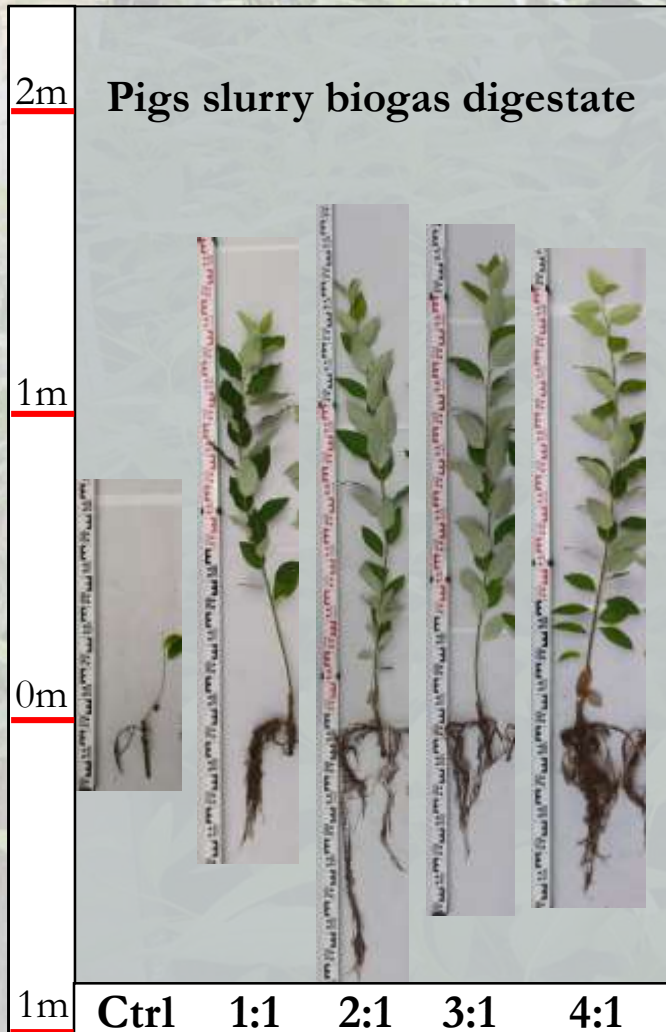


Chlorophyll content index  
(CCI) measurements  
using spectrophotometer

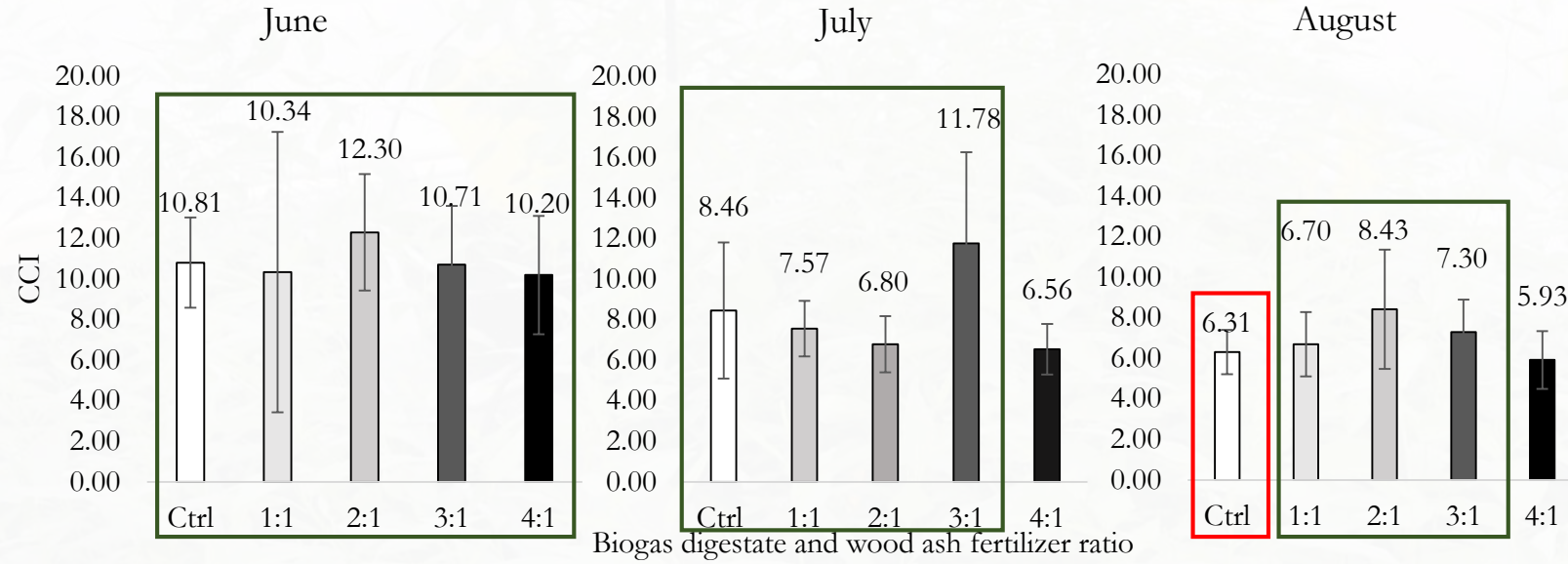
# Auce



# OP42 (syn. Hybride 275)



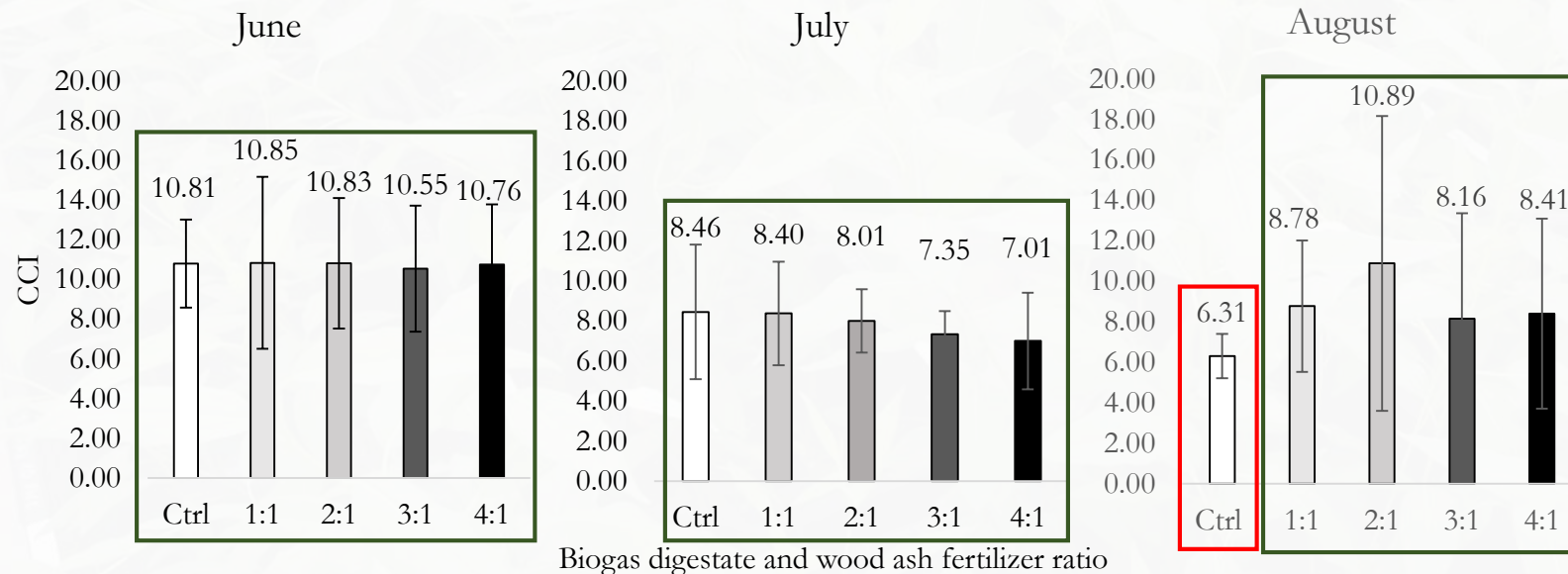
Pigs slurry biogas digestate



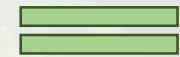
Chlorophyll  
content  
index (CCI)

Control group chlorophyll content

Cattle slurry biogas digestate

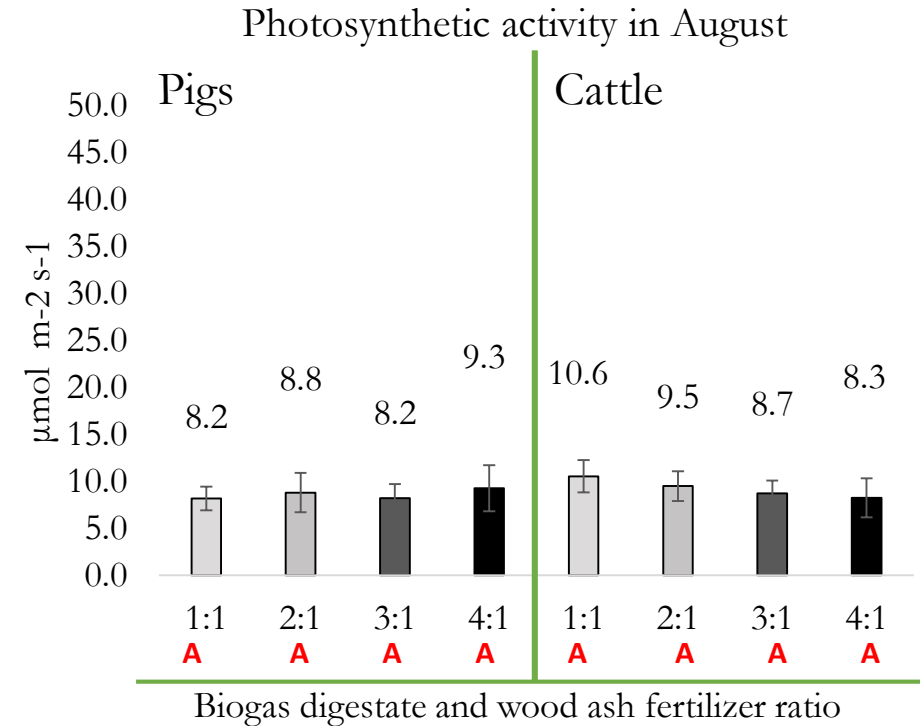
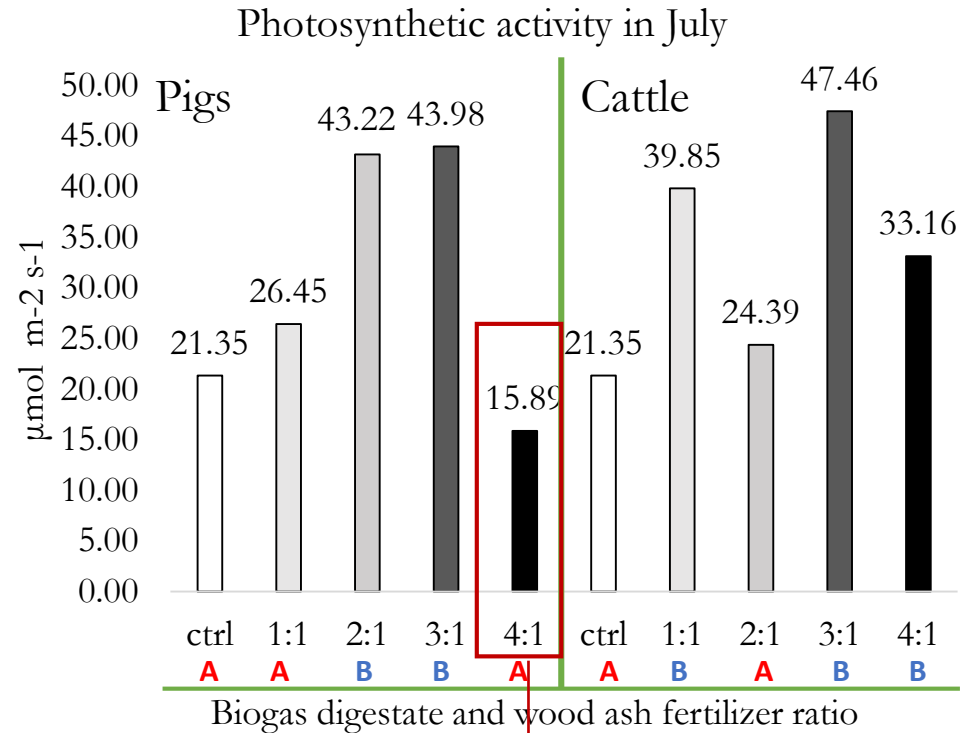


Chlorophyll degrades  
faster in  
Control group leaves



**Fertilization  
prolongs the  
growing season**

# Net photosynthetic rate (A)



**Overfertilization?**

..shoot dry mass does not show decrease

# Plans for next year...



28. Conifer stand 4 years after planting



29. Drone photograph of conifer stand 4 years after planting

Potential use of fertilizer in conifer stands in Latvia

Preparation and application of fertilizer in the study area



30. Making of fertilizer mixtures



31. Soil sampling



31. Applying fertilizer on conifer stand in 2021 winter

## Main points

1. Industrial by-products as a mixture of biogas digestate and wood ash can be successfully used to achieve better survival and growth of poplar cuttings in marginal lands
2. Although in some cases higher digestate fertilizer showed even better viability (significant differences between 1/1 and higher digestate doses), even at low doses it is possible to obtain relatively much better survival and vitality than in the control group.
3. The Auce clone has significantly longer shoots (cow biogas digestate,  $p=0.01$ ), but smaller leaf mass ( $p=0.01$ ). Although the shoot dry mass in most variants does not differ significantly from OP42 clone (exception pig digestate 1/1)
4. In most cases there were no significant differences in shoot dry mass between the types of digestate
5. Fertilization may extend the growing season

## The aims for future:

1. Macroelement content in the soil and plants (shoots, leaves and roots)
2. Biogas digestate and wood ash fertilizer use in conifer stands

**Development of a new technology for production of plant fertilizers from fermentation by-products of biogas production facility - cogeneration residue**

Link to project: <http://www.laukutikls.lv/jaunas-tehnologijas-izstrade-augu-meslosanas-lidzeklu-razosana-no-biogazes-razotnes-fermentacijas>

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