



# Investigating Clover Protein for Organic Pork Production

Notes from my visit to Denmark

May 2019

Jude Becker

# Why an alternative to soy?

- Soy has driven expansion of Midwest pork industry for decades.
- Offers a competitive advantage versus other global regions. “Corn/Soy” flavor-
- No vegetable alternative can match the CP content with lysine balance.





# Emerging Consumer Preference and Climate/Environmental issues

- Facing increasing negative feedback from customers on soy use in pig diets.
- As pressure to sequester carbon increases on the Ag sector, row crop monocultures will become less desirable.

# Cost of certified organic soybean meal a burden on pig farm economy

- Major financial stumbling block for organic pork has been cost of feed over the past 20 years.
- Many farms have sought alternative sources of protein that were more internalized/renewable and less cash intensive.



# Trip to Denmark/ Aarhus University

- Following Midwest Organic Pork Conference in 2019, opportunity to visit Denmark arose.
- Heard about “Clover Protein” project.

# Factors of project origination in Denmark

- **Why protein from grass is so interesting-changing annual crops into grass land**
- •EU animal production is largely dependent on imported proteins (mainly soya).
- •EU report on the development of plant proteins in Europe (November 2018).
- •The climate load from animal production has to be reduced –more carbon sequestration in grass.
- •Less nitrate leaching from grassland
- •Danish environmental programs for coastal waters. Report suggest 25 % of land in grass for protein production.
- •Difficult to supply organic pig and poultry with organic and locally produced proteins. Combined with nitrogen deficiency in organic plant production.
- •Growing demand for organic products.
- •Better conditions for insects and wildlife / higher biodiversity.

# Limited supply of protein for current market demands, similar argument could be constructed in the U.S.

## THE PROTEIN CHALLENGE: INCREASING POPULATION AND MEAT IN THE DIET

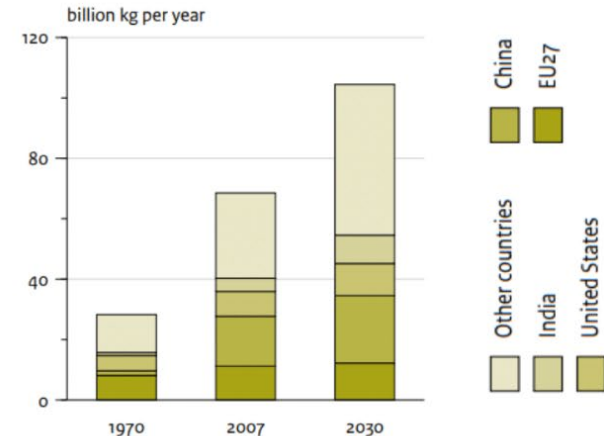
# 70 pct.

Total global consumption of animal proteins from 2007 to 2030 may increase by around 70 percent; an increase in the demand for plant-based proteins for food is also expected.

Westhoek, H. et al., 2011. The Protein Puzzle - the consumption and production of meat, dairy and fish in the European Union. FLB Netherlands Environmental Agency 218 pp

### Supply of animal protein

World



Source: Based on FAO (2006a, 2010a)





# ENVIRONMENTAL REASONS FOR BIOREFINING GREEN CROPS

More perennial green biomass will have several positive environmental impacts.

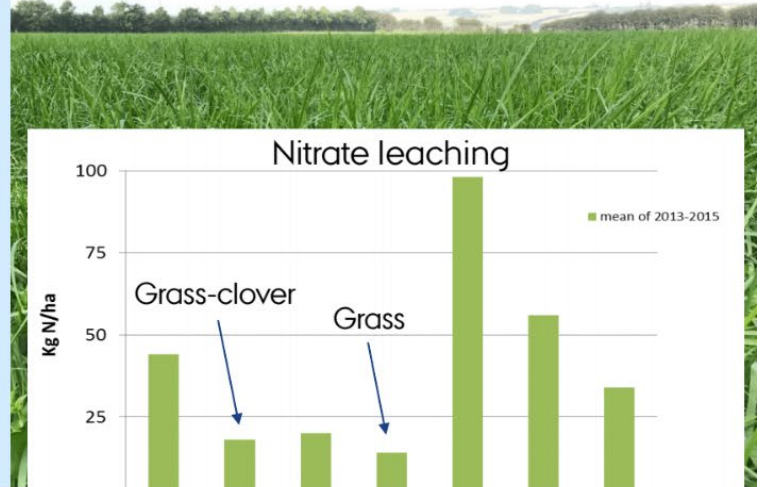
- **Reduced Nitrate leaching compared to cereals and corn**
- **No pesticide use necessary**
- **Positive soil carbon input (around 1 ton C/ha)**
- **Increased biodiversity using crop mixtures (even herbs)**

Manevski, K., et al., Nitrogen balances of innovative cropping systems for feedstock production to future biorefineries (2018) Science of the Total Environment, 633, pp. 372-390.

Manevski, K., et al., Biomass productivity and radiation utilisation of innovative cropping systems for biorefinery (2017) Agricultural and Forest Meteorology, 233, pp. 250-264.

Cong, W.-F., et al., Species interactions between forbs and grass-clover contribute to yield gains and weed suppression in forage grassland mixtures (2018) Agriculture, Ecosystems and Environment, 268, pp. 154-161.

We are specifically focusing on  
Grasses, Clover and Lucerne



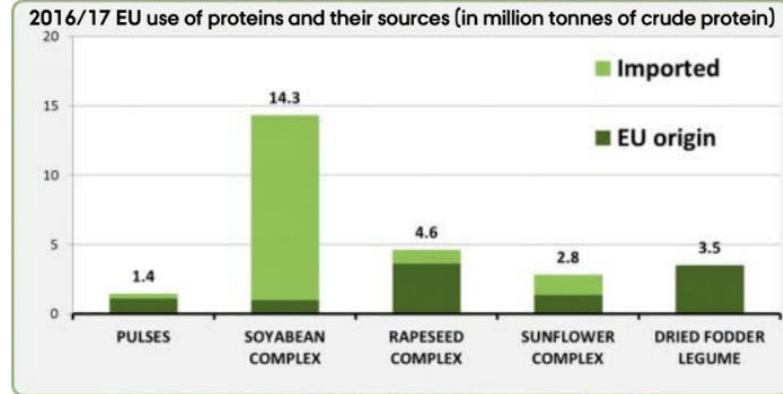


# THE PROTEIN CHALLENGE: PROTEIN DEFICIT IN EU

- Meat production in EU is 63% dependent on soy import
- Equal to a production area the size of England
- Increased soy production adds to deforestation and soil depletion
- EU food industry is vulnerable to world market changes



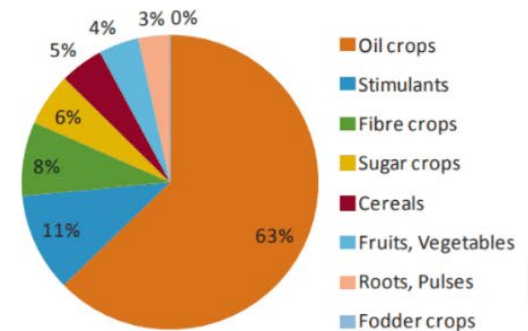
REPORT FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT on the development of plant proteins in the European Union, Brussels, 22.11.2018 COM(2018) 757



Source: EU Commission. "Complex" includes meals, seeds and beans

D. Cuypers, et al., Impact of EU Consumption on Deforestation: Comprehensive Analysis of the Impact of EU Consumption on Deforestation. European Commission, Technical Report - 2013 - 063 (2013)

**Deforestation embodied in traded crop commodities, by crop groups, for the period 1990-2008, totaling 22.4 Mha**



# Arhus University

## PILOT/DEMO FACILITIES AT AU FOULUM





# DEPARTMENT OF ENGINEERING CENTER FOR BIOREFINING TECHNOLOGIES CBT

Process development and  
Upscaling of biorefining  
technology

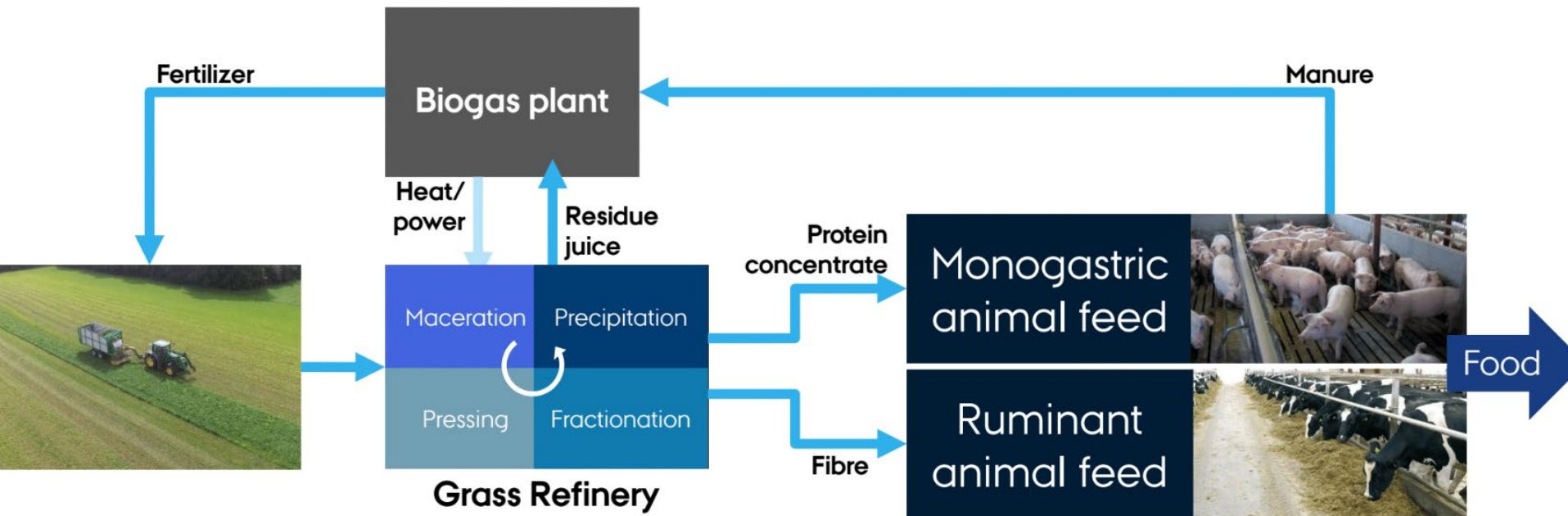
Pilot facilities for  
biobased production and  
process integration





# PROTEIN FEED FROM GREEN BIOMASS

## BASE CASE SCENARIO











## Danish research and innovation projects on grass proteins

- **MultiPlant:** Developing a multi species concept of forage for grass protein and biogas.
- **SuperGrassPork:** Feed value of grass protein for pigs and further development of the biorefining process.
- **GreenEggs:** Egg quality and production on grass protein combined with green leaves from willows in the hen yard.



# Concept Background

Multiple attempts have been made in the U.S. to derive a suitable protein supplement from hay and forage legumes such as clover and alfalfa. Most have not met with the intended results.

To my surprise, the effort in Denmark was based on using the liquid content of the plant rather than the dry material. This is a central concept.

As plant dries following cutting, protein adheres to dry material in plant and following this is no longer separable. Time is of the essence!







After green material is conveyed into chopper at even flow rate, it is ground through this roller grinder.

Most desirable mixture is clover or alfalfa. Certain other grass species and weeds present at very low percentages are acceptable.

Some weeds, however, will cause issues for machinery at even low rates.



This weed had flowers and early seed head structures which plugged the screen. Even a small presence was causing issues for operation the day of our visit.



## Harvest technique is important for protein yield and quality



**SEGES**

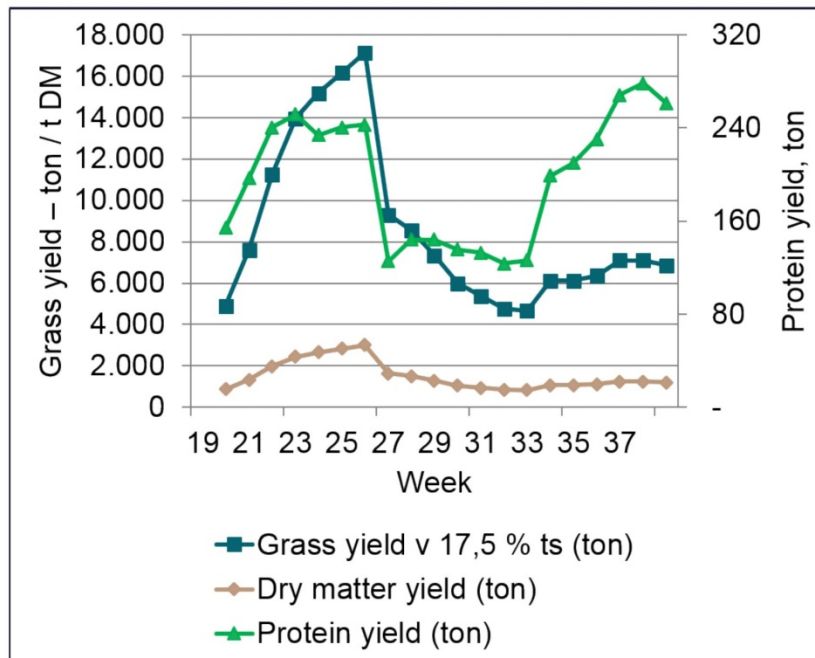
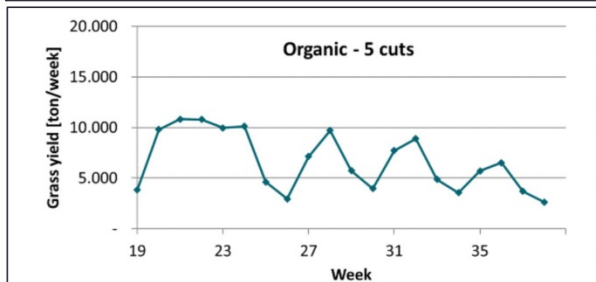




## Season variations have to be managed

- Calculated yields during the grass season.
  - 3000 ha
  - 5 cuts
  - 4 blocks of 750 ha

4 blocks of 900, 1050, 600 and 450 ha



Ground material is pressed through screens to extract “juice”.







Liquid content  
prior to drying  
contains protein  
and nutrients

Final dried product ready for inclusion in ration





Protein conc.

DM = 10-20%

Protein = 30-60%



## High protein yields in legume rich forage

Crop	Yield (ton DM / ha)	Protein Kg / ha	Lysine Kg / ha	Methionine Kg / ha
Grass – clover mixture	13	2600	200	90
Alfalfa	12	2600	200	90
Peas	6	1300	92	13
Field bean	6	1500	92	11
Soy-bean (US)	3	1050	65	14

Modified from S. Krogh Jensen, Aarhus University



# LATEST FEED TRIAL SUBSTITUTED 100% SOY WITH GREEN PROTEIN

## WITH NO NEGATIVE EFFECT ON WEIGHT GAIN AND FEED UTILIZATION

1,2 ton DM Grass-clover protein concentrate production 2018

High protein concentration in the product batches (45-55%)

Grass-clover protein concentrate	
Water content	1,8 %
Crude protein	47,0 %
Fat	11,3 %
Ash	12,3 %

Feeding from 8 Nov. to 7 Mar.

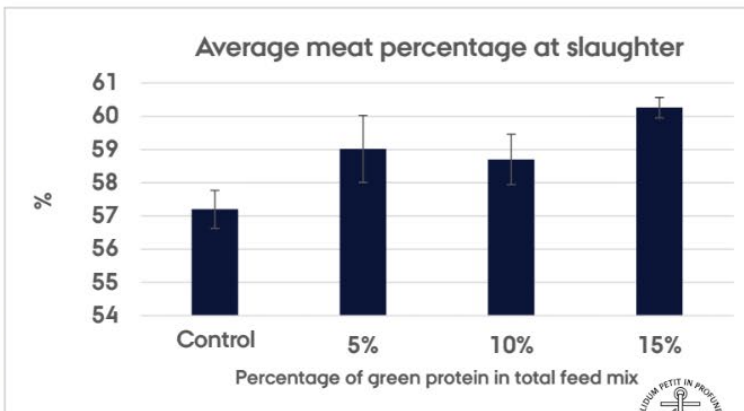
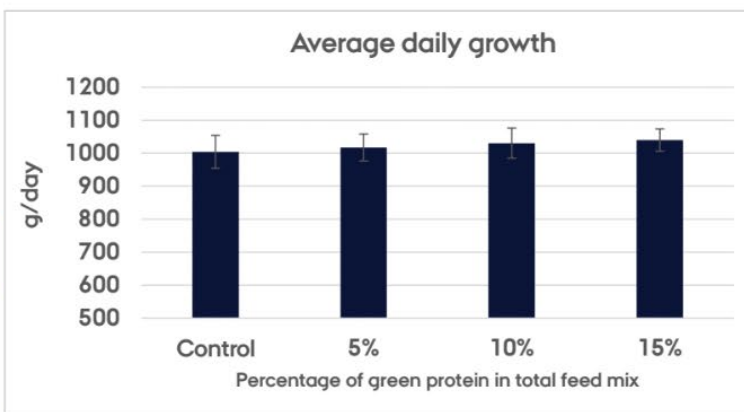
4 feed groups (Control, 5, 10, 15%)

Total of 48 pigs

Essential amino acids [g/16 g N]		
	Grass-clover conc.	Soy meal
Lys	6,04	5,98
Met	2,24	1,31
Cys	0,70	1,43
Thr	4,71	3,92
Trp	2,17	1,36
Ile	5,19	4,91
Leu	8,82	7,68
His	2,26	2,61
Phe	5,84	5,06
Val	6,41	5,19
Arg	6,02	7,23
Glu	11,04	17,78

SBFC, SEATTLE  
30 APRIL 2019

MORTEN AMBYE-JENSEN  
ASSISTANT PROFESSOR



From S.K. Jensen and L. Stødtkilde-Jørgensen



## *Financial Results at Plant and Farm level*

Clover protein is priced to the farm at same level as 5 year average of organic soybean meal, non-gmo soybean meal, and commodity soybean meal.


Returns for the plant/factory were negative for the commodity soybean meal, slightly negative for the non-gmo soybean meal, and positive for the organic soybean meal.

More work needs to be done, but “cheapness” of commodity soy will likely be difficult to compete against.



## *Possibilities in Midwestern U.S.*

- Adequate soy is available at present, limited amounts of imported soy.
- Following visit in 2019, Ernie Peterson of Cashton Farm Supply made follow up visit to Aarhus, DK.
- Interest level along with feasibility is being investigated at Cashton Farm Supply.



Thank you for your attention

**SEGES**

