

Development of improved injection technology for placement of slurry to maize (Slurry maize)



Promilleafgiftsfonden for landbrug



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Study tour Holland, October 2021

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The slurry maize project

- A four-year project funded by the Danish GUDP (2018-2022)
- Participants
 - AU-engineering
 - AU-Crop
 - Samson Agro
 - The Danish farm contractor association (DM&E)
 - Varde Maskinstation (contractor)
 - SEGES
- Main aims
 - Development of technologies for improved utilisation of slurry applied to maize
 - Documentation of yield and environmental impact of improved technology
 - Demonstration of developed technology by farm demonstrations and on-farm studies
 - Collection and dissemination of knowledge related to project results.

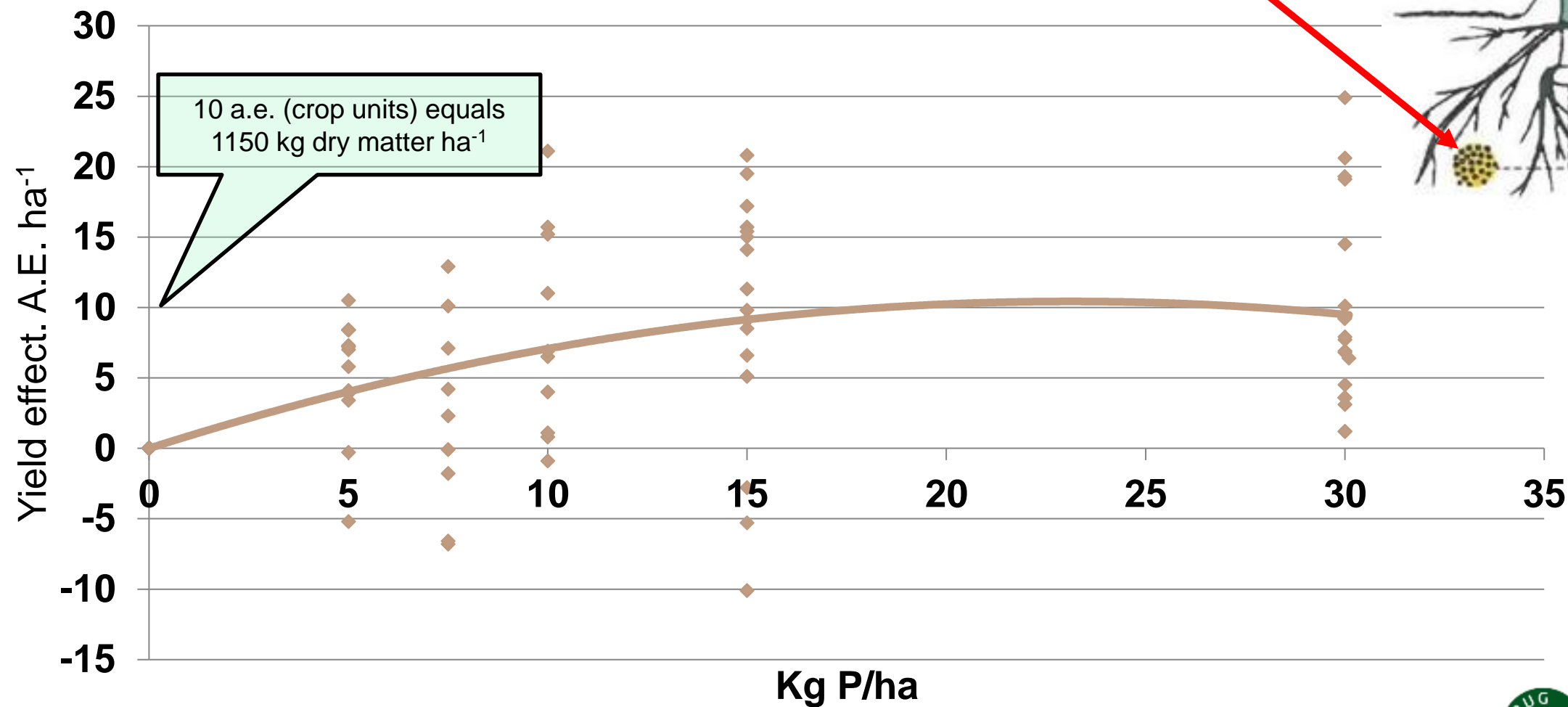
Denmark is situated close to the northern border for maize production



So, low temperatures – especially in spring - is restricting crop development. Due that most Danish farmers apply fertilizer P (start P) to secure enough available P to the young crop.

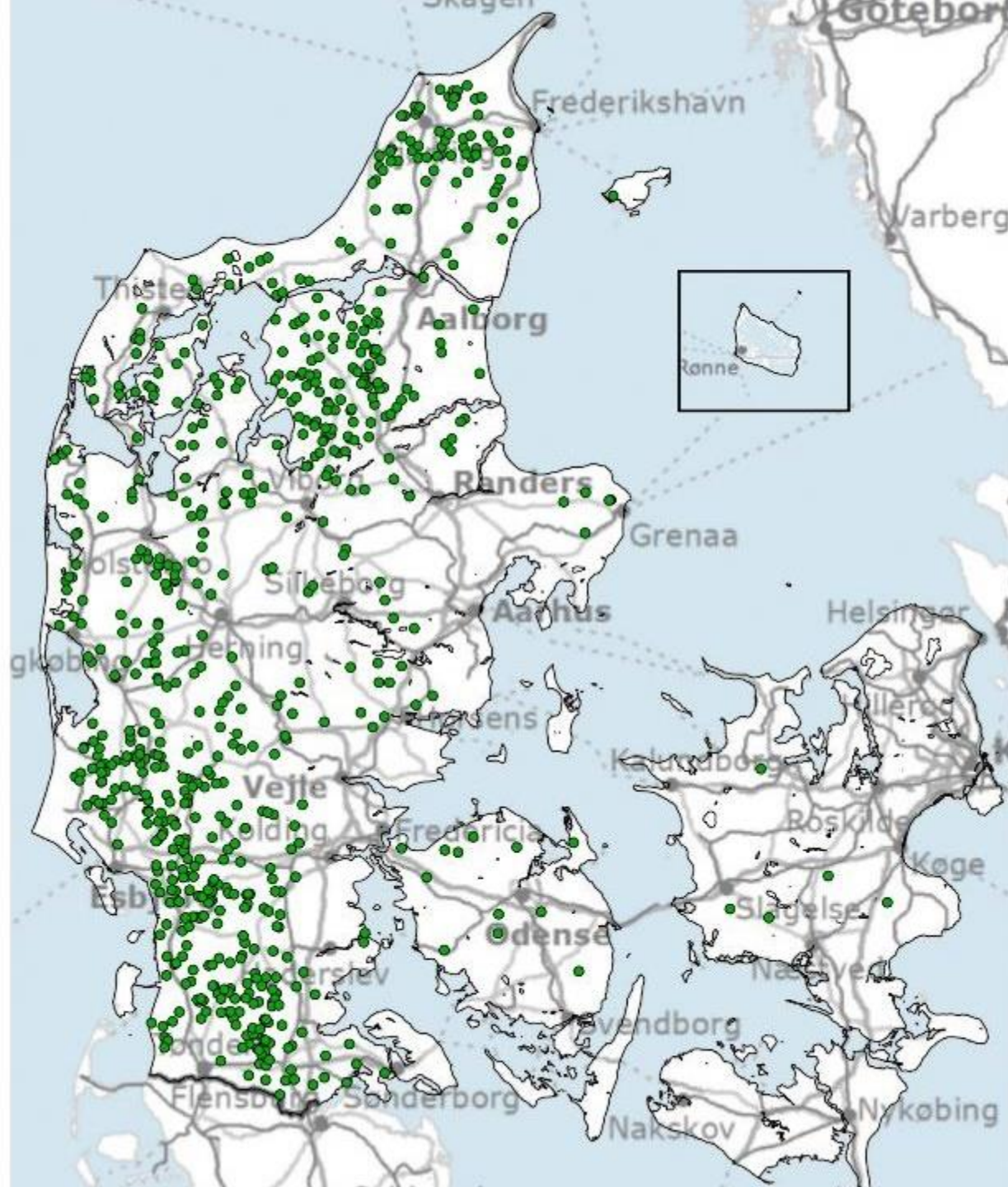
Yield effect of mineral start P to maize

26 Field trial studies 2003 - 2017



New Danish phosphorus regulation in 2018

Production type	N-Ceiling, kg N ha ⁻¹	P-ceiling, kg P ha ⁻¹
Dairy production	170	30
Dairy production, derogation	230	35



The new P regulation restricts the use of start P in maize production.

Dairy farms

Max 30 kg P ha⁻¹ year⁻¹

Dairy farms, derogation

Max 35 kg P ha⁻¹ year⁻¹

Green dots show dairy farms that do not have the ability to use start P as before.

No more starter P

What do
we do?



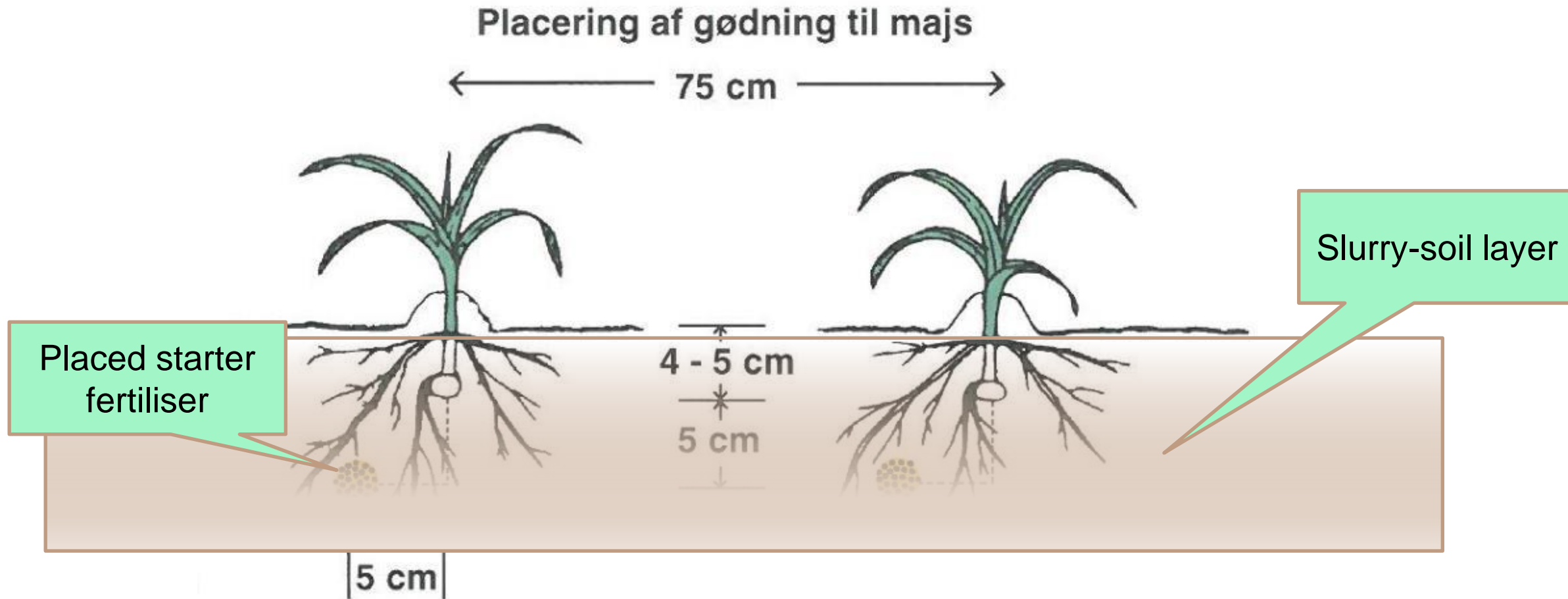
All slurry applied to uncropped land has to be deep injected in Dk



Standard method (reference system):

1. Soil injection of slurry
2. Ploughing or harrowing
3. Seeding og maize and placement of starter fertiliser

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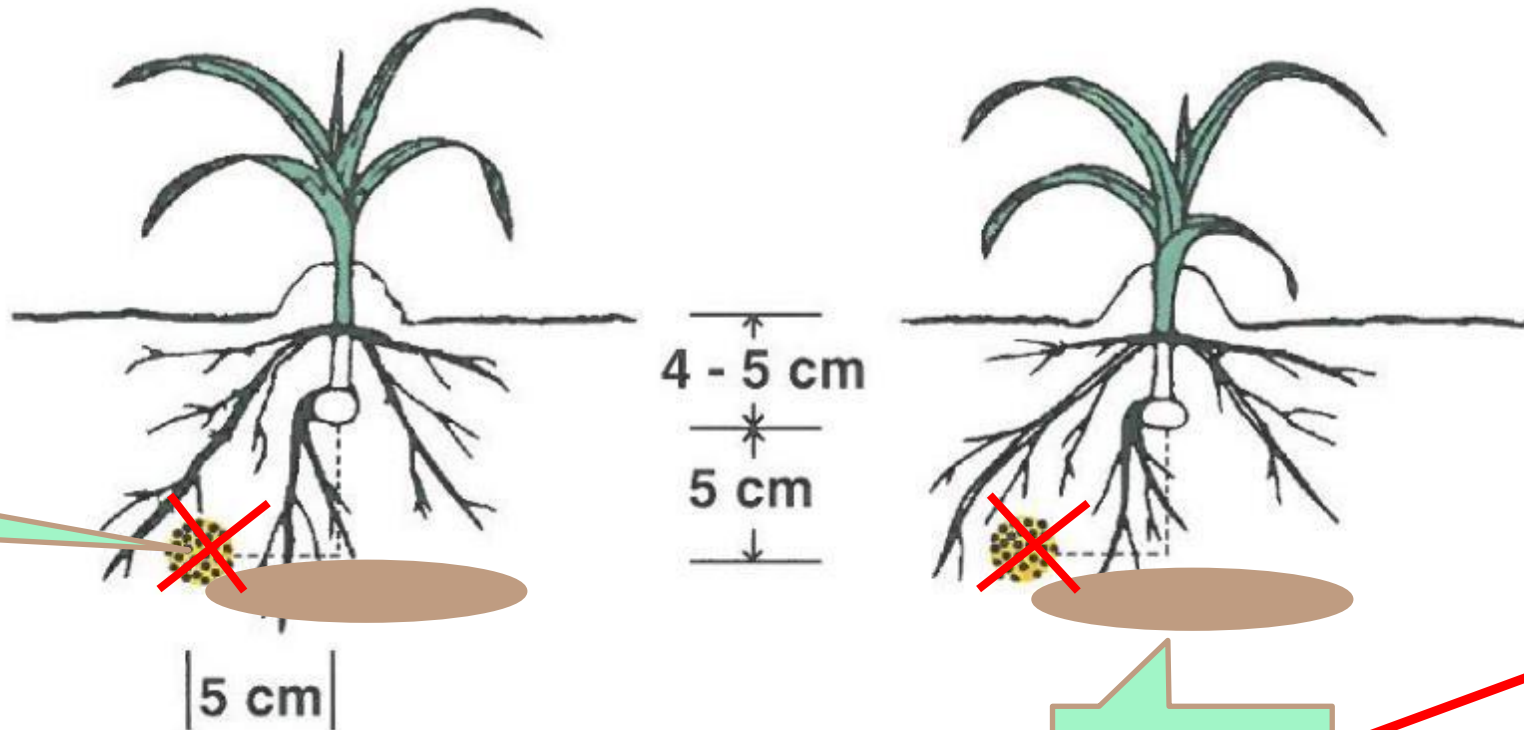


Placement of slurry:

1. Ploughing or harrowing
2. Slurry injection 10-12 cm below soil surface
3. Seeding of maize 5 cm above the surface of the applied slurry by gps.

Placering af gødning til majs

← 75 cm →



No starter
P

Placed
slurry



Field trials often show that placement of slurry increases maize growth and yield.

At the picture shown, the maize to the left has been applied placed slurry without P starter, while the maize to the right has been applied slurry by traditional slurry injection – and application of 15 kg starter P pr. ha

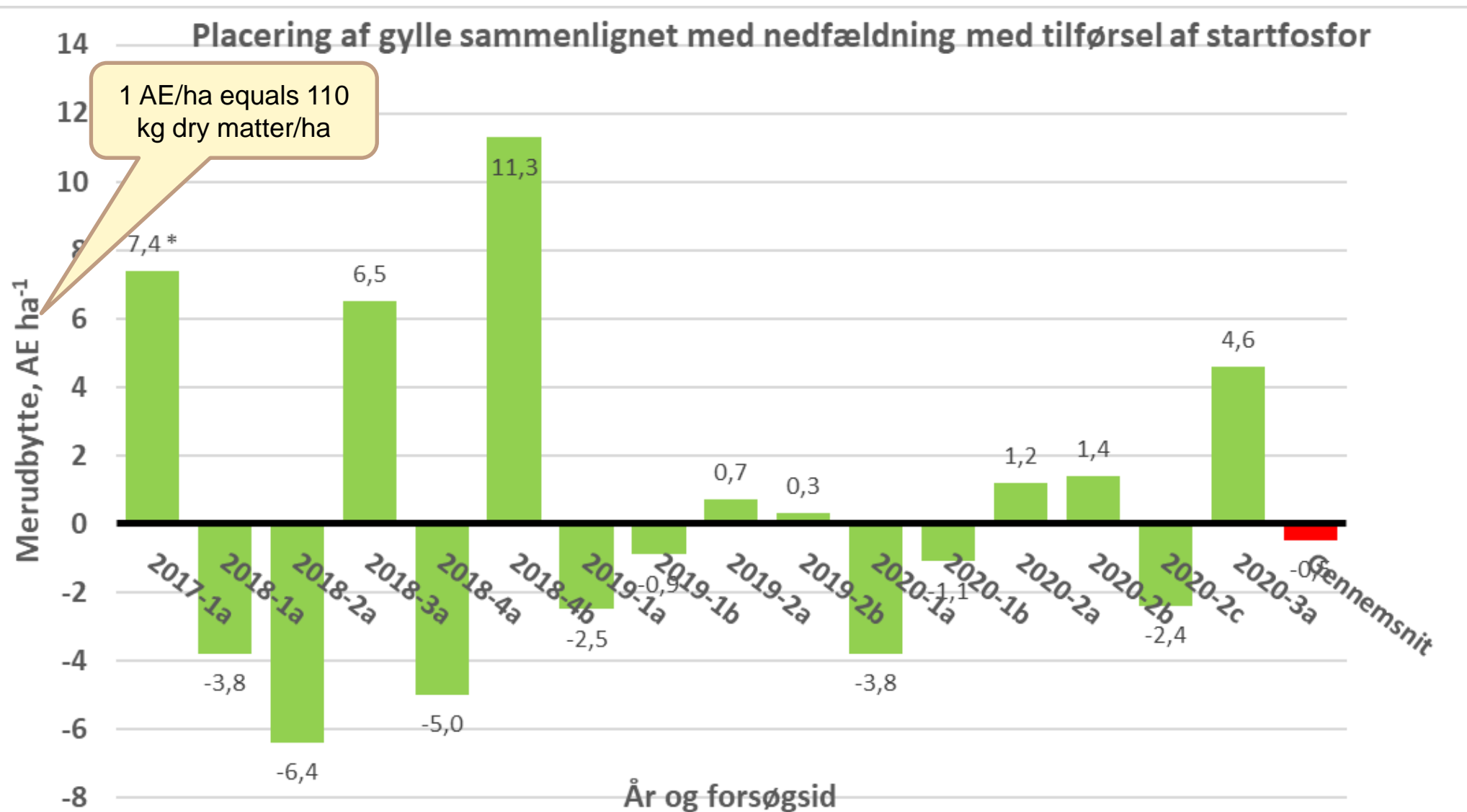
However, effects varies between trials and year.



Placement of slurry can replace the need of starter P

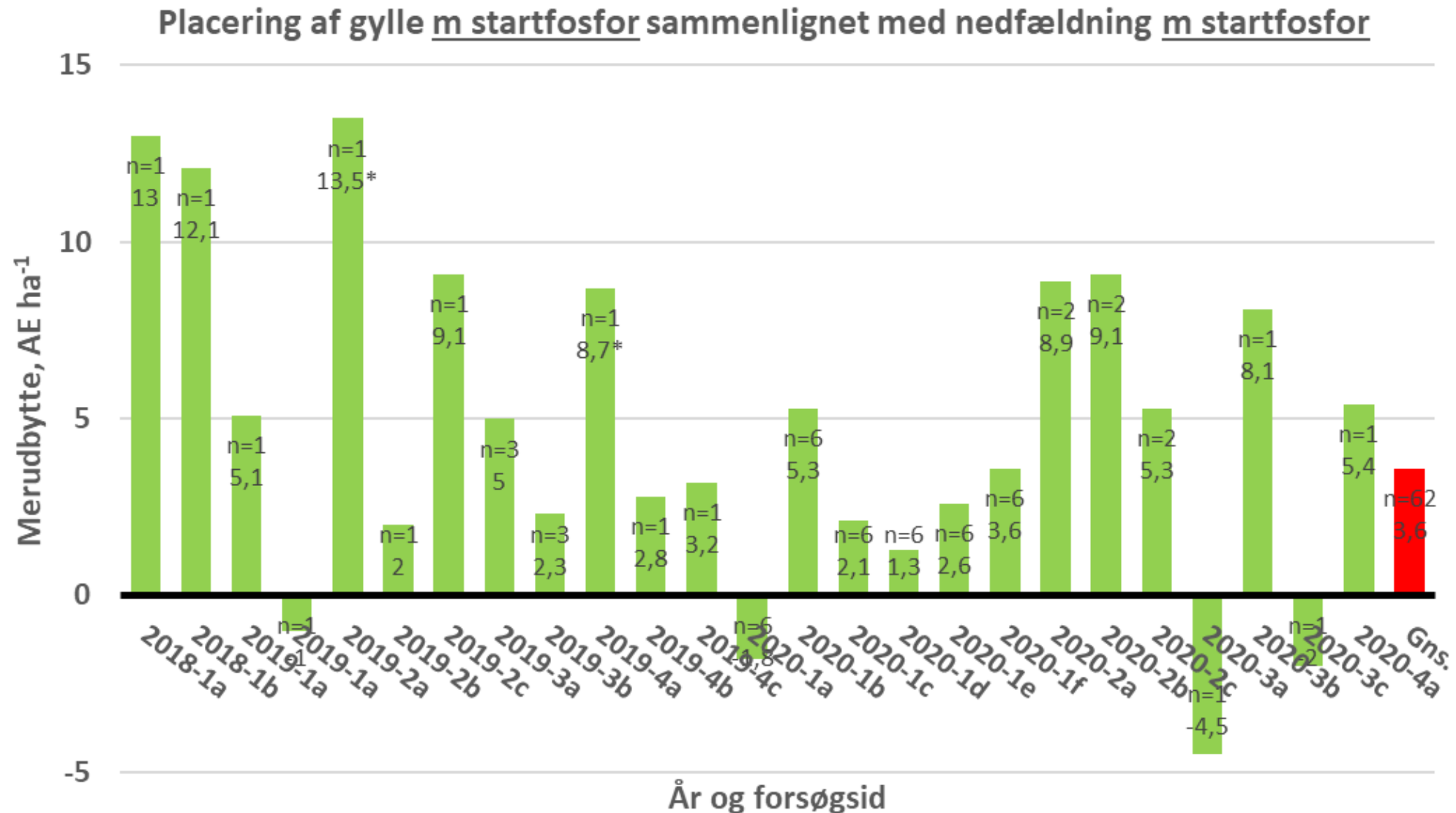
Additional yield of placed slurry (without starter P) relative to standard slurry application (given 15 kg starter P per ha)

17 field trials 2017- 2020



Given the same amount of starter P, placement of slurry normally gives higher yield

16 field trials, 2018 til 2020

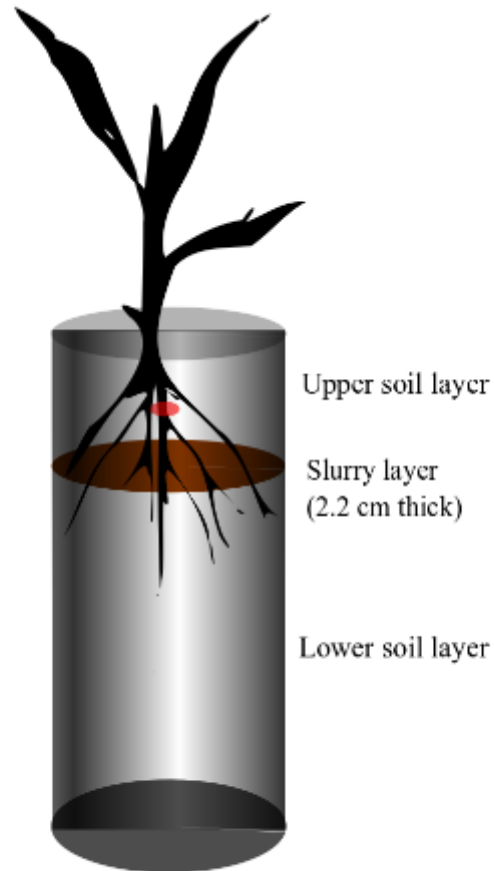


The importance of correct depth

Lab studies at AU

Slurry were placed in four different depth:

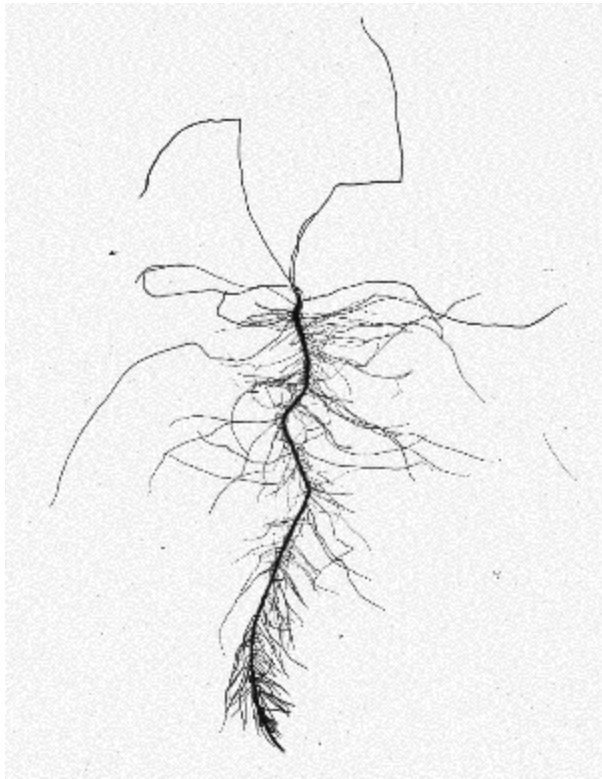
- 1.5 cm below seed
- 5 cm below seed
- 8.5 cm below seed
- 12 cm below seed



Soil samples were placed in a climate chamber during growth.

Impact of slurry depth on root development

Primary root when slurry was placed 12 cm below seed.



Primary root when slurry was placed 1.5 cm below seed

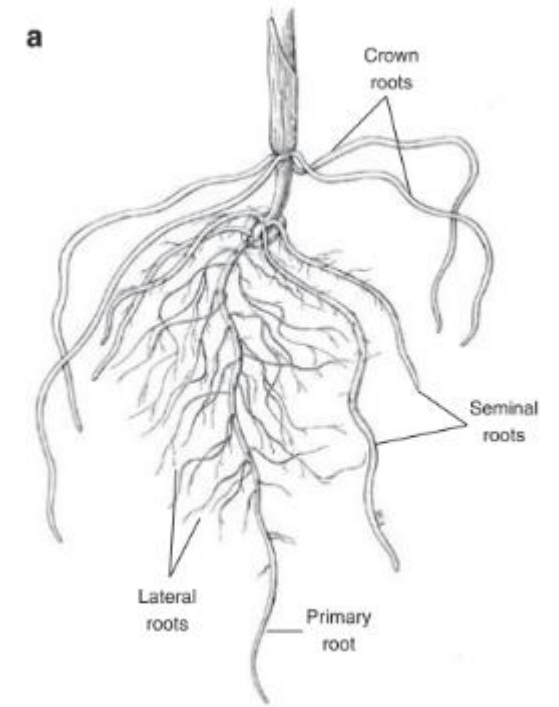
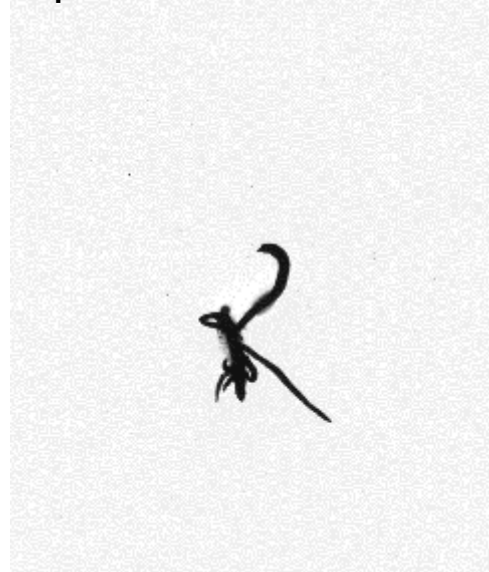


Figure 1. Hochholdinger (2009).

Depth regulation works well in strip-till systems, but is challenged in ploughed soil.



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The project has developed an optimized slurry injection system for placement of slurry to maize



The experimental slurry injector has been used in field trials in 2019 - 2021

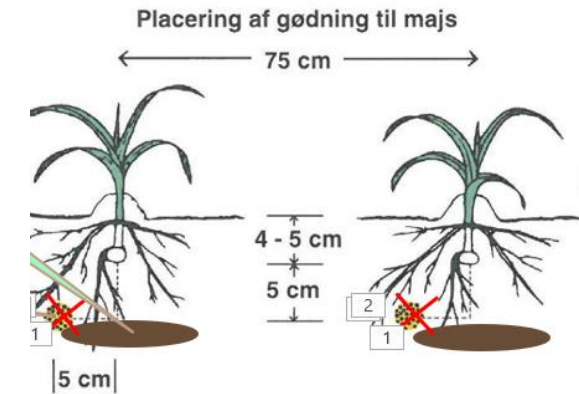
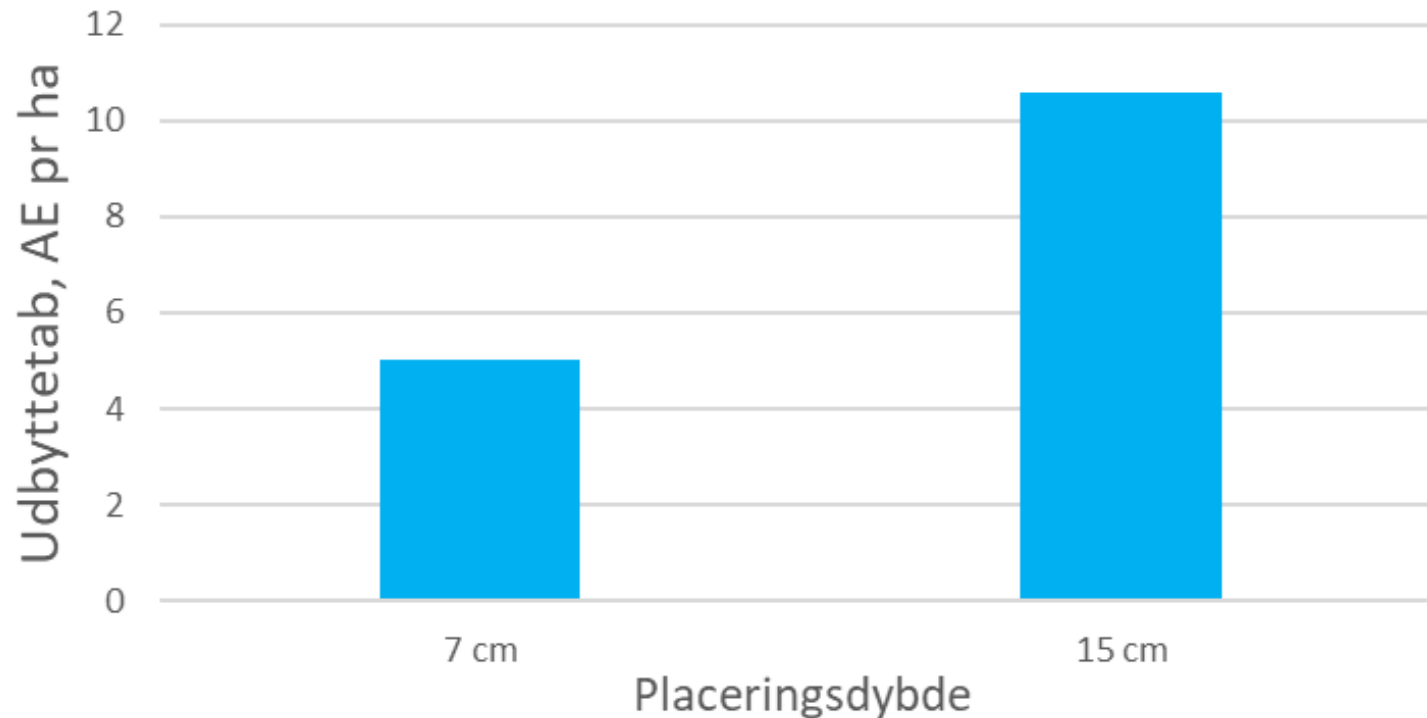


The slurry has to be placed in 10 cm depth.

- Higher or lower placement cause loss of yield.

3 field trials, 2019 og 2020

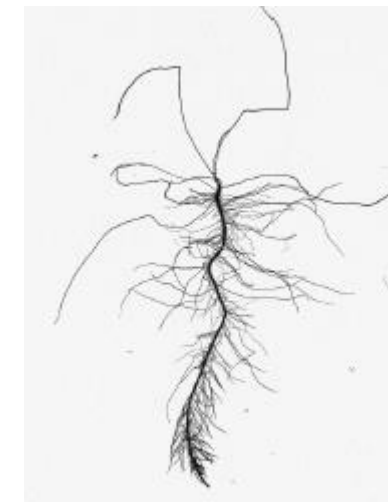
Loss of yield, if the slurry is placed 7 and 15 cm below soil surface, compared to 10 cm.



Effect of distance between slurry and maize seed on root development. Pedersen I. F. AU, 2018.

Root development at 12 cm distance between seed and slurry

Root development at 1.5 cm distance between seed and slurry



A lot of digging has been done to see, how slurry is distributed by different tine systems – and to what depth.

- The yield and nutrient effects have been studied by means of field trial studies

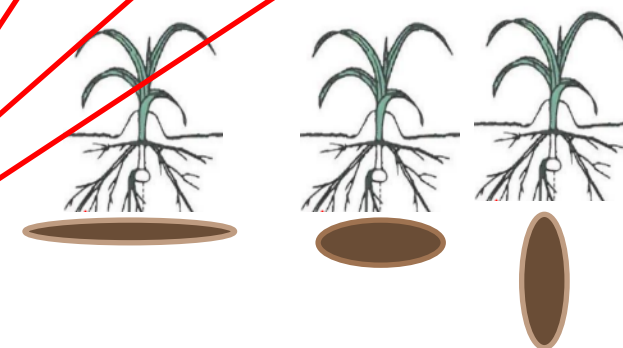


The design of tines effects crop yield

3 field trials 2019 and 2020

TabU 11. Placement of cattle slurry to maize at plough soil. (U15, U16)

Maize	Start-fert, kg pr. ha		NH ₄ -N in slurry, kg pr. ha	Treatment of soil, before or after slurry application	Slurry application system ¹⁾	Tine design ²⁾	Liter Vizura pr. ha	Yield and additional yield. pr. ha	
	N	P						hkg raw protein	NEL ₂ a.e.
2019 og 2020. 3 field trials in ploughed soil.									
1. 27	0	127	Ploug, after	Trad. Inject., 10 cm	Nedfældertand	2	11,0	134,9	
4. 27	0	127	Ploug, before	Placed, 10 cm	Goose foot-3	2	1,0	6,9	
7. 27	0	127	Ploug, before	Placed, 10 cm	Goose foot-2	2	0,8	3,0	
8. 27	0	127	Ploug, before	Placed, 10 cm	Goose foot-1	2	0,8	2,9	
								ns	ns



Additional yield

An improved injection system for placement of slurry to maize has been developed in the project (prototype)



An important aim of the project has been dissemination of results and improved technologies. The disseminations have been aimed farmers, contractors and plant advisers



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Dissemination types

Field demonstrations



Conferences and workshops



Social media

Professional articles in farmer news

<https://www.facebook.com/planteavl/videos/186665559973061/>

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Summing up

- A new phosphorous regulation has restricted the use of starter P to maize in Denmark
- That requests a higher and faster utilization of the nutrients in applied slurry
- Field trials have shown that placement of slurry without application of starter P gives similar yields as traditional slurry application with application of 15 kg starter P/ha
- Given the same amount of starter P, placement of slurry gives higher yield than traditional slurry injection
- Slurry placement to maize is challenging regarding correct depth, draught requirement and capacity.

Positive proof of global warming.

<https://www.facebook.com/planteavl/videos/186665559973061/>



**18th
Century**

1900

1950

1970

1980

1990

2006

Questions and comments



Questions and comments





Tak for opmærksomheden
– og god weekend