Intense drainage improves N balance in a ley experiment

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The experimet

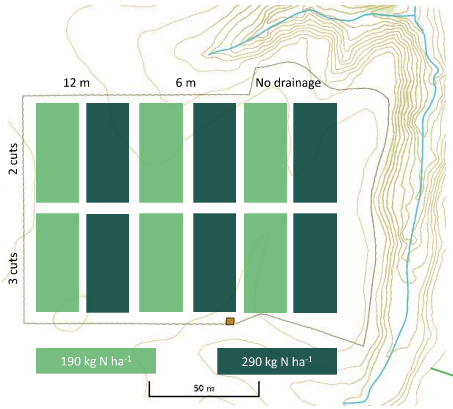

Figure 1: Schematic layout of the experiment. There were two drains for each green, drained plot, and two harvesting plots for each drain.

From 2014-17, an experimental trial was carried out at Askvoll (61°20 N, 5°6 E). Precipitation was 2500 mm yr^{-1} and average temperature 8.5 °C, both measured on site.

One objective of this field experiment was to study the effect of increased drainage on yield and N balance.

The main soil type was a Mollic to Umbric Gleysol, sandy silt to silty sand with 10 – 20 % LOI in the topsoil. The soil was highly variable, which is typical for the region.

Drainage pipes were installed in autumn of 2013, at 1 – 1.2 m depth, with 6 or 12 m spacing or not at all.

The field was sown and measurements commenced in 2014. Drain pipe discharge was measured by tipping buckets, with fortnightly collection of volume proportional samples.

There were either two or three cuts a year and two different fertilizer levels.

Each combination of drain spacing, cuts and fertilizer were assigned to two different drainage pipes, with two harvested plots served by each pipe (figure 1).

Yield was measured 2015 to 2017, dried and analysed on near infrared spectroscopy (Fystro & Lunnan 2006). In 2017, only two cuts were made on the three cut regime, due to wet conditions.

Statistics were done in SAS.

References:

Fystro G, Lunnan T. (2006) Analysar av grovfôrkvalitet på NIRS. Bioforsk FOKUS 1 (3): 180-181.

SAS 9.4, SAS Institute Inc. Cary. NC. USA

(Additional references in the Book of abstracts)

The situation

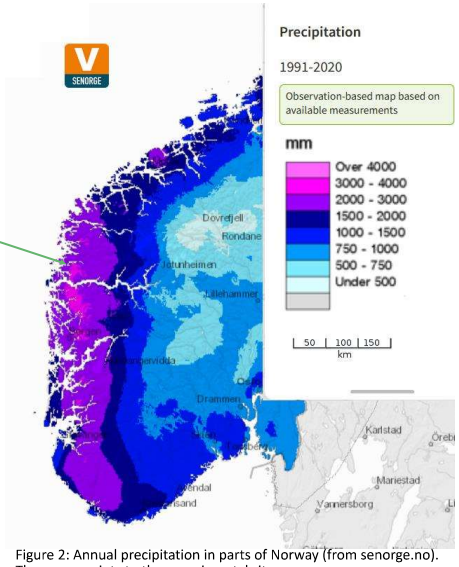

Figure 2: Annual precipitation in parts of Norway (from senorge.no). The arrow points to the experimental site.

The large amounts of rainfall in western Norway (figure 3) necessitates intense drainage for the soil to be reliably suitable for cultivation, and to provide an optimal environment for plant growth.

Insufficient drainage reduces yields and restricts the farmer, who may have to choose between suboptimal timing of fertilizing and harvest, or risk long-term damage of the soil due to compaction.

Still, drainage has received little attention for decades.

Subsurface drainage remove some of the excess water, but is often not sufficient by itself. Additional evapotranspiration is needed, but as plant roots require air to function, waterlogging can restrict transpiration. An intensified subsurface drainage may thus allow the plants to transpire enough water more quickly.

Drainage may help plants to reach higher yields, better N balance and more flexibility for the farmer.

Conclusions

- Small yield increase
- Better N utilisation
- A lot of water goes missing
- High variability makes everything difficult
- Maybe aim for more surface runoff at low conductivity soils?
- The few modern expermients have not yet given enough attention to the question of drainage

The results

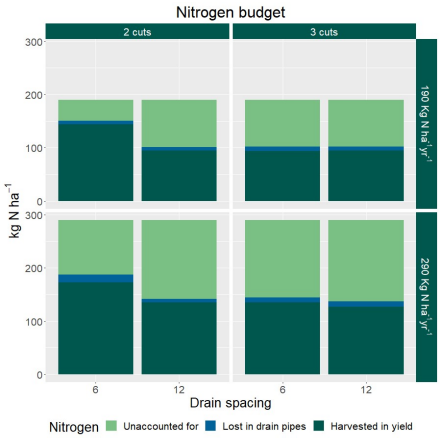

Figure 3: Fractions of applied nitrogen fertilizer – where does it end up, and how much are we able to account for?

The N budget in figure 3 shows a higher utilization of N with 2 cuts and 6 meter spacing. This is also the treatment with the highest yields (figure 4).

High yield indicates healthy plants with a high water consumption and ample opportunity to intercept nutrient.

With two cuts, the plants are large and healthy for a longer time.

Two cuts also allows less traffic on the field, and thus the risk of damaging the plants or compacting the soil is lowered.

Only at the two cut – 6 meter drain spacing treatment does potential evapotranspiration and water from the drainage pipe add up to over 50 % of precipitation.

High soil variability both between and within treatments complicates both predicting and explaining the quantitative effect of the drainage intervention.

Increased drainage removes drainable water more quickly, lowers the ground water table and may allow for healthier plants who can helped retaining the water and utilizing the fertilizer.

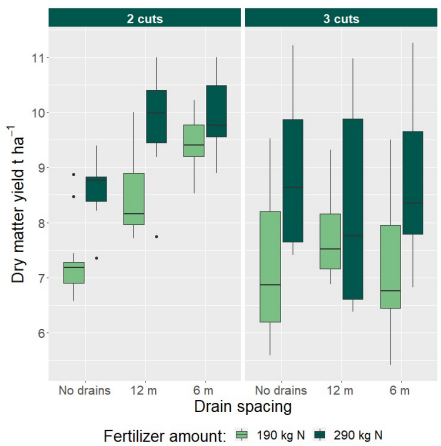

Figure 4: Dry matter yields, average of 2014 - 2017.

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