Perennial leys for dairy cows: soil and plant attributes, yield and botanical composition with long-term low and high N input

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What is the long-term impact of cow manure slurry application?

For 7-years we have been studying the effects of high and low application of cow manure slurry on:

- Soil properties
- Plant nutrient concentrations
- Ley yield
- Botanical composition

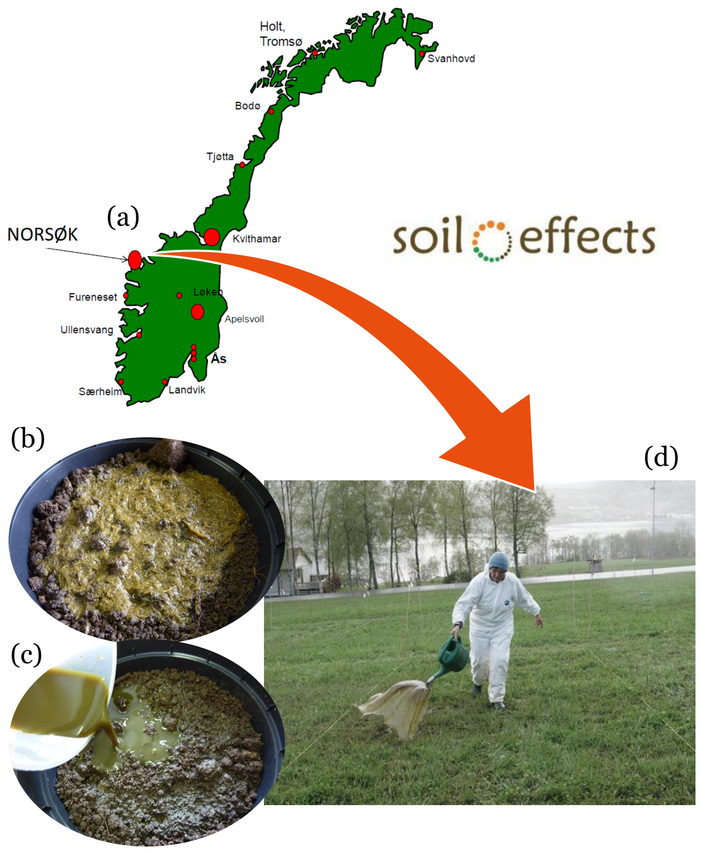

Fig.1. (a) Location of our field experiment, Tingvoll, Norway; (b) Undigested and (c) Digested cow manure slurry; (d) Slurry application.

Field experiment consisted of two organic fertilizer types (digested and undigested slurry) and two application rates, 110 and 220 kg total N ha^{-1} yr^{-1}.

Fig.2. Biogas plant under construction in 2010, Tingvoll farm, Norway.

Plots were cultivated with perennial grass-clover ley. There was no significant difference between the average values of the parameters evaluated for the digested and undigested manure. Thus, results of treatments with high N input were combined to represent intensive farming systems, while low N input treatments represent organic farming systems.

Results

Fig. 3. Fertilization supports early growth. Photo April, 2016: «OR» = organic; «IN» = intensive; «C» = control.

Despite the double amount of manure, cumulative ley yield (2011-18) was only 17% higher ($p<0.001$) in the intensive as compared to the organic treatments. In 2018, yield levels were affected by drought.

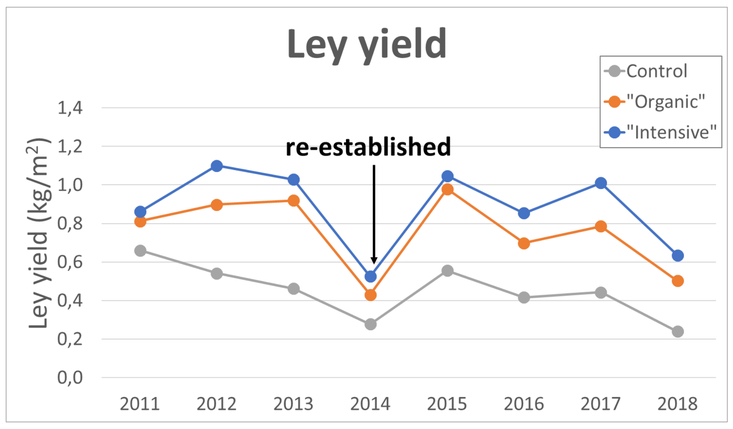

Fig.4. Average ley yield, 2011-2018.

As expected, after 7 years, AL-extractable phosphorous (P) and potassium (K) concentrations in soil were significantly ($p=0.002$) higher in the intensive treatments than in the organic treatments.

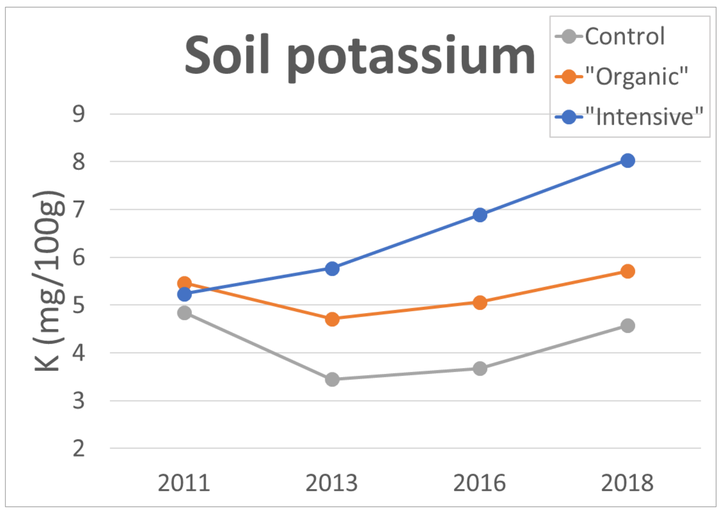

Fig.5. Extractable soil potassium concentration over the years (2011-2018).

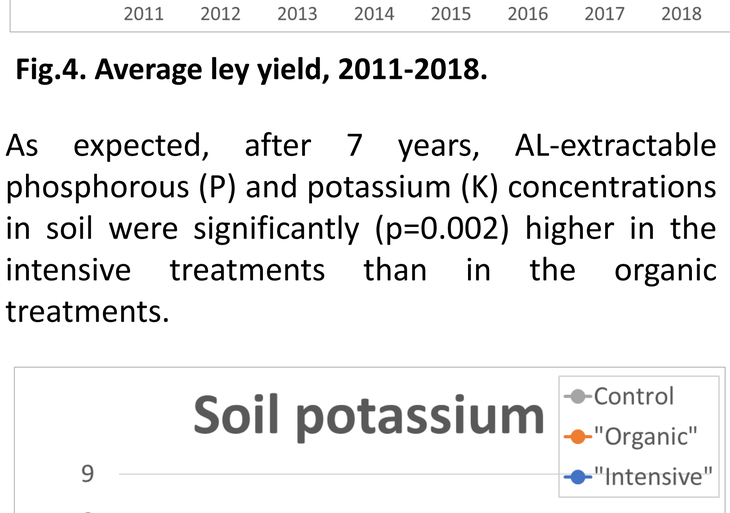

Fig.6. Extractable soil phosphorous concentration over the years (2011-2018).

NUE was 140% for the organic treatment, suggesting that more N was removed by ley yields than it was applied with manure. Intensive treatment had a NUE of 82%. Low NUE indicates excessive use of fertiliser that may cause environmental pollution.

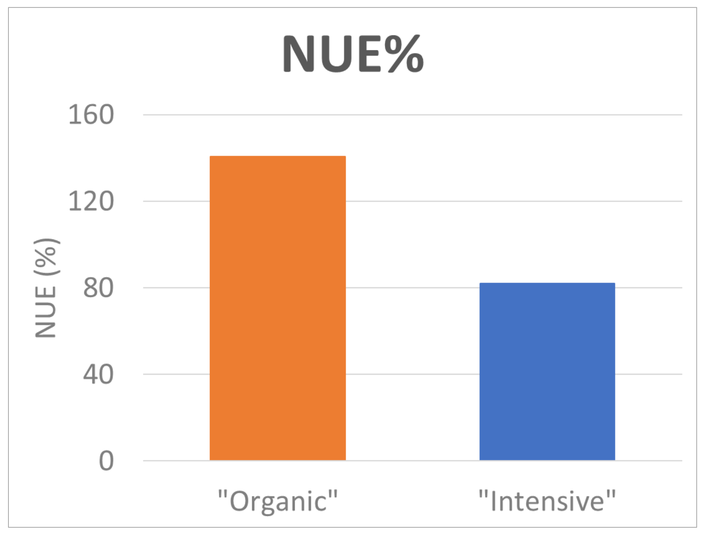

Fig.7. Average (2011-2018) N use efficiency (NUE%) was calculated as NUE% = N removed (in ley yields) / N applied (manure) x 100.

Botanical composition was affected by N application rates, with significantly less clover ($p=0.008$) and more grass ($p=0.003$) in the intensive treatment.

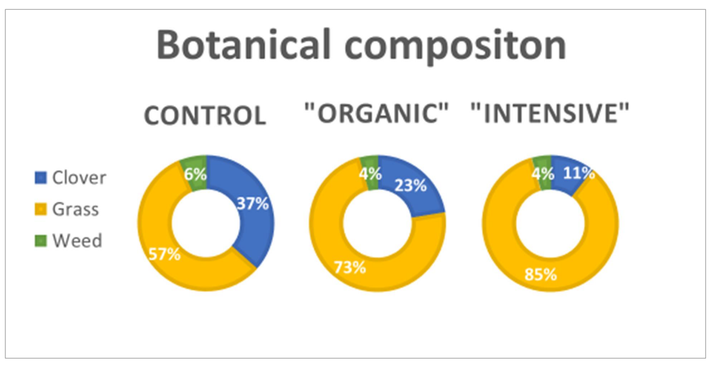

Fig.8. Botanical composition of the grass-clover ley in 2015.

Conclusion

Overall, our findings indicate that in the long-term, high N input farming systems do not necessarily translate in significant gains of ley yield when compared to low N input systems. NUE and clover content of the ley will be reduced with higher N input.

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soil effects
www.norsok.no/en/projects/2015/effects-of-anaerobically-digested-manure-on-soil-fertility-the-field-experiment-soileffects

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