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

Tatiana Francischinelli Rittl and A. K. Løes

Norwegian Centre for Organic Agriculture (NORSØK), Tingvoll, Norway

E-mail: tatiana.rittl@norsok.no

Soil chemical properties, plant nutrient concentrations, yields and botanical composition were studied in a high (mimicking conventional) and low nitrogen (N) input (mimicking self-sufficient organic) farming system over 7 years in a field experiment in Tingvoll, Norway. The two-factor experiment consisted of two organic fertilizer types (digested and undigested manure from organically managed dairy cows) and two fertilizer application rates, 110 and 220 kg total N ha\(^{-1}\) yr\(^{-1}\). All, treatments and control, were cultivated with perennial grass-clover ley, re-established once during the study period. There was no significant difference between the average values of the above-mentioned characteristics evaluated for the digested and undigested manure, except for K concentration in the ley (2018). Thus, results of treatments with high N input were combined to represent conventional farming systems, while low N input treatments represent organic farming systems. As expected, after 7 years, AL-extractable phosphorous (P) and potassium (K) concentrations in soil were significantly (p=0.002) higher in the conventional treatments than in the organic treatments. Despite the double amount of manure, cumulative ley yield (2011-18) was only 17% higher (p<0.001) in the conventional than in the organic treatments. In 2018, concentration of P in the aboveground plant material was significantly higher in all fertilised treatments than in the control (p=0.041), and significantly higher in the conventional than in the organic treatments (p<0.001). N use efficiency (NUE\%) was calculated as NUE\% = N removed (in ley yields) / N applied (manure) x 100. NUE\% ranged from 102-163\% for the organic treatments, suggesting that more N was removed by ley yields than it was applied with manure. This N may derive from soil or biological N fixation. Conventional treatments had a NUE between 59 and 96\%. Low NUE\% indicates excessive use of fertiliser that may cause environmental pollution. Botanical composition of the grass-clover ley (2015) was affected by N application rates, with significantly less clover (p=0.008) and more grass (p=0.003) in the high N input treatments. Overall, our findings indicate that in the long-term high N input farming systems do not necessary translate in significant gains of ley yield production when comparing to low N input systems. NUE and clover content of the ley will be reduced with higher N input.