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Organic nitrogen fertilisation of spring cereals

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Introduction

One problem in organic cereal production is poor grain quality resulting from low grain protein content. The objectives of these experiments were to improve grain yield and quality through application of organic N-fertiliser. The effects of green mulch fertilisation, slurry fertilisation, and of both fertilisers applied simultaneously to spring wheat were studied. On spring barley, the effect of green mulch fertilisation, slurry fertilisation, and the possible effect of the previous year's treatment on spring wheat were of interest. The experiments were done at Kourla organic research farm of the Agric. Engineering Research Unit at Vihti in southern Finland.

Materials and methods

Eight strips were prepared for the cereals, each 6 m wide and 80 m long, containing four 15 m sample blocks. The strips were alternated with nine 6 m wide red clover/grass strips. Spring wheat (row spacing 0.25 m) was grown in 1998 followed by barley (row spacing 0.18 m) in 1999. N-fertilisation was done between tillering and stem elongation. Cuttings from the clover/grass strips were used as green mulch. Green mulch was cut and distributed using a prototype spreading machine developed at the Agric. Engineering Research Unit. Slurry was distributed in 1998 by band spreading on the soil surface with a dribble hose attachment (about 80 kg N_{tot} ha^{-1}), and in 1999 by watering can (about 70 kg N_{tot} ha^{-1}). Weed control was carried out twice in each year using a machine hoe developed at the Agric. Engineering Research Unit. All treatments were carried out on four replicate blocks. Records were taken of yield and N-content of straw and grain, grain quality, nitrogen content of soil (N_{min} at tillage, before harvest and in autumn at 0.25 m depth), quantity and nitrogen content of applied green mulch and slurry, temperature and precipitation.

Results and discussion

Spreading 2.3 t ha^{-1} dry matter green mulch in 1998 corresponded to 45 kg N ha^{-1} and 2.5 t ha^{-1} in 1999 corresponded to 43 kg N ha^{-1}. The green mulch partly covered the cereals causing damage and slightly lowered grain yield in both years. In 1998 the highest grain yield was reached after slurry fertilisation. Application of green mulch plus slurry indicated that slurry compensated for the yield depression caused by green mulch fertilisation. Green mulch application increased the proportion of weed seeds in harvested grain in the second year. In 1998 the highest average straw yield followed slurry fertilisation while green mulch caused straw yield to be depressed. In 1999 there were no differences in straw yield between different treatments. Protein content was slightly improved from 11.8 % to 12.2 % in 1998 after green mulch fertilisation. Slurry fertiliser application resulted in 13.8 % protein content and green mulch plus slurry fertiliser in 14.4 %. Similar trends were reflected in thousand-grain weight and hectolitre weight. Falling number exhibited a contrasting trend. The best quality wheat was harvested in 1998 following slurry application. Green mulch application slightly improved quality. In 1999 barley had a mean protein content of 14.1 - 14.2 %, independent of fertiliser treatment. In 1998 precipitation was high and mean temperature was low, causing abundant growth of the green mulch but a delay in its time of application. In 1999 precipitation was low and mean temperature high. This resulted in poor growth of the green mulch and required harvest and transport of additional green mulch from a fallow plot.

Conclusions

Green mulch fertiliser seems not to be a suitable nitrogen fertiliser for southern Finland. Timing of production of sufficient green mulch is unreliable. Mineralisation of green mulch is probably too slow, especially at low temperatures and during long-lasting dry periods. An area ratio of 2:1, green mulch to cereal, may ensure that the target nitrogen quantity of about 80 kg N ha^{-1} is reached. A long-term effect of green mulch fertilisation was not recorded. Slurry fertiliser may improve grain quality under suitable weather conditions, but the drought in 1999 probably caused nitrogen losses from both green mulch and slurry.