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Phosphorus and nitrogen uptake of spring cereals in different tillage systems

Alakukku, L.

MTT Agrifood Research Finland, E-House, FI-31600 Jokioinen

Present address: University of Helsinki, Department of Agrotechnology, P.O. Box 28,
FI-00014 University of Helsinki, Finland

Tel: +358919158682, Fax: +358919158491, E-mail: laura.alakukku@helsinki.fi

The conventional Finnish tillage system for spring cereals involves mouldboard ploughing. Currently, farmers have been increasingly interested in conservation tillage systems, e.g. stubble cultivation and direct drilling (zero tillage). In this study, the effects of reduced tillage intensity on the yield of spring cereals (barley (*Hordeum vulgare*) and oats (*Avena sativa*)), and the phosphorus (P) and nitrogen (N) uptake of crop were examined in two field experiments on clay soils. The objective of the study was to investigate the yield quantity and nutrient use efficiency of spring cereals when the tillage intensity on clayey soil was reduced. In the present paper, the results of the first 4 to 5 experimental years (transition period) are discussed.

Field experiments were conducted on a clay soil (Vertic Cambisol, in 2000), and a clay loam soil (Eutric Cambisol, in 2001) at Jokioinen in southwestern Finland. In the layer of 0-20 cm, the mean clay (< 0.002 mm) content was 0.62 g g⁻¹ and 46 g g⁻¹ for clay and clay loam soils, respectively. The experiments were laid out in randomized complete-block design with four replicates. The treatments were: (PA) autumn ploughing to 20-25 cm depth and combined rotary harrowing and combi drilling in spring; (SA) stubble cultivation (10-15 cm) and spring tillage and sowing as in PA, and (NC) zero tillage in autumn and in spring sowing with a direct drill (seed and fertilizer placed in the same row). The grain yield, and the P and N content of grain were determined annually. The P and N yield harvested in grain yield was calculated.

On the clay soil, the mean grain yield of stubble cultivated and direct drilled treatments was 3 and 18% less, respectively, than that of ploughed treatment. The relative reductions in P and N uptake were of the same magnitude as the grain yield reductions. On the clay loam soil, the differences in yields and crop nutrient uptake between treatments were clearly smaller than on the clay soil. The mean grain yields of ploughed, stubble cultivated and direct drilled treatments were 4490 (100%), 4410 (98%) and 4330 (97%) kg ha⁻¹, respectively. On direct drilled plots the P uptake was 10% and the N uptake 8% less than in ploughed plots. The reduction of tillage intensity can act upon the nutrient uptake in different ways because it impacts e.g. on soil structure and nutrient reactions in the soil. The reasons for the reductions in nutrient uptake are, however, not evident from the present data.

The present results originated from a 'transition' period to direct drilling. More experimental years are needed to evaluate the long-term effects of direct drilling on grain yield and nutrient uptake.