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Soil compaction related to root growth of cover crops and N dynamics

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According to the EU Nitrate Directive, agriculture in Flanders needs to reduce nitrogen (N) leaching to ground and surface waters. Apart from adjusting fertilization management, one of the measures to reach this goal is to grow cover crops in autumn. These crops prevent N-leaching during winter months. Arable land in Flanders is subject to compaction due to the use of heavy machinery under wet conditions. In this research, it was questioned what the impact of compaction is on the below and aboveground cover crop growth and their efficiency to take up N throughout the growing season. To investigate this, two cover crops, i.e. Italian ryegrass (Lolium multiflorum Lam.) and white mustard (Sinapis alba L.), were sown the 29th of August 2008 at three different locations in a field plot in Merelbeke (Belgium). These locations represented three different situations, i.e. headland (A), normal (B) and wet conditions (C). At each location, a randomised block design was established with three replicates. Apart from Italian ryegrass and white mustard, there was a third treatment with bare plots. The soil type of the field plot is anthric Albeluvisol with a sandy loam soil texture, a pH-KCl of 6.2-6.9 and a carbon content of 1.0-1.1%. Soil compaction was measured with a penetrologger and Kopecky rings in spring. Mineral N in the soil profile (0-90 or 0-210 cm) and above and below ground biomass parameters were measured in October, November and February. These parameters were aboveground dry matter yield, N content of the aboveground biomass, rooting depth, root length, root length density and root density. Penetration resistance was significantly higher on the headland (A) than in B and C for the 15-30 cm soil layer and significantly higher in A than in C for the 30-45 cm soil layer. Aboveground biomass was very variable on the headland. Therefore, locations with low yield (Alow) were sampled separately from locations with normal yield (Anormal). Although it was our hypothesis, these yield differences could not be attributed to differences in soil compaction. Increased soil compaction restricted rooting depth to 30-40 cm on the headland in contrast to 50-60 cm in B and C. No location effects were detected for the other root parameters. Due to the different rooting systems, the other root parameters did differ between the two cover crop types. N-uptake in October was higher for white mustard than for ryegrass because of the fast early crop development. This difference had disappeared in November. This was reflected in the fact that mineral N content in the 0-90 cm soil profile (residual N) did not differ for both crop types. Except for in Alow, the cover crop plots had a significant lower residual N than the bare plots, showing their efficiency to take up N during autumn or winter. Mineralisation in the bare plots between the end of August and October, was lower in A than in B and C. This could be explained by the higher soil compaction in A which limits mineralisation.