

Effects of age and cutting frequency on belowground plant biomass in grass-clover

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Significant amounts of plant biomass and fixed N are incorporated into soil as roots, nodules and root exudates during the growth of grass-clover, which consequently is exposed to soil microbial degradation when the field is ploughed. This has major implications for our understanding of the potential contributions of legumes in the N economics and losses in grass-clover cropping systems. We have studied the effects of grass-clover pasture age and cutting frequency (simulated grazing) on the development of the above ground as well as the below ground plant biomass, with emphasis on below-harvest contribution to the total N₂ fixation.

Methodology

N₂ fixation in grass-clover mixtures was determined using the ¹⁵N dilution method with accompanying ryegrass as reference plant. Aboveground biomass (AGB) under mowing conditions was determined from cuttings at 3-4 weeks intervals, whereas the AGB under simulated grazing conditions ('grazing') was determined from cuttings at 1-2 weeks intervals. Belowground biomass (BGB) was determined by sampling soil columns in steel cylinders (diameter 20 cm and height 20 cm) followed by washing off the soil, while the plant material was carefully separated into grass stubble, clover stubble including stolons, grass roots and clover roots.

Effects of age on biomass production

In total, the amounts of nitrogen harvested during the growing season of 2001 were 183, 231 and 181 kg N ha⁻¹ in the 1st, 2nd and 8th year grass-clover pastures, respectively. This nitrogen was in the experimental plots removed from the field, but would under grazing conditions to a great extent via urine and excreta be returned to the pastures. Additionally, a considerable amount was present in roots and stubble at the end of the growing season (92, 135 and 154 kg N ha⁻¹ in the 1st, 2nd and 8th year pastures, respectively), with a major part (45-72%) present in the grass roots. The amount of N in clover stubble and roots and in grass stubble did not seem to be affected by pasture age, whereas the content in grass roots increased considerably with age.

Effects of cutting frequency on biomass production

As for the harvested biomass, the below harvest plant biomass, left in the field at the end of season, was affected by cutting frequency. Both the amount of stubble/stolons and roots was significantly higher after mowing than after 'grazing', resulting in a below-harvest biomass being 4 and 2.5 times the harvested biomass, respectively. This resulted in total amounts of nitrogen left in the field at the end of the growing season at about 150 N ha⁻¹ in the mowed and 100 kg N⁻¹ in the 'grazed' treatment.

Preliminary conclusions

In summary it is concluded that

- the total below-harvest plant biomass and amount of nitrogen increases with increasing pasture age. The grass components contribute more to the increase than the clover.
- frequent cutting ('grazing') reduces biomass production in the harvested as well as the below-harvested components.