

Multispecies perennial forage legume and grass mixtures for improved nitrogen supply of organic arable cropping systems

7. Diversified agroecological cropping systems for sustainable food systems

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Nitrogen (N) management is central for sustainable food production: N limitation may lead to food insecurity while N surplus may cause environmental degradation. Integration of perennial forage legumes in arable cropping systems provides inputs of biologically fixed N, reducing the need for energy-demanding N fertilizers. We conducted a three-year field experiment in an organic arable cropping system at the Swedish University of Agricultural Sciences (SLU), Alnarp, Sweden. The experiment included four forage legumes (*Medicago sativa*, *Melilotus officinalis*, *Lotus corniculatus* and *Trifolium repens*), and four grass species (*Phleum pratense*, *Dactylis glomerata*, *Festuca pratensis* and *Lolium perenne*) in pure stands and mixtures of different composition. Variation in plant productivity, legume biological N₂ fixation and N acquisition as affected by species choice and composition of perennial forage legumes and grasses were assessed under low and high cutting frequency. The majority of the legume-grass mixtures were as productive as the highest performing legume or grass pure stands, and the mixtures generally competed more strongly against weeds than pure stands. Legumes derived up to 90% of their N from N₂ fixation, and this was often higher in legumes grown in mixtures with grasses. Total N accumulation in harvested biomass was highest in pure stand of *M. sativa*, followed by legume-grass mixtures which in turn accumulated more N than grass in pure stand. Root N concentration varied between species composition in the same pattern as total aboveground N accumulation, whereas total root biomass and amount of N did not vary significantly between species mixtures and cutting frequencies. The study provides insights about the resource efficiency of N acquisition in perennial forage legume-grass mixtures. Including multispecies forage legume-grass mixtures in rotation with arable crops systems may improve productivity, multifunctionality and the overall sustainability of organic arable cropping systems.