The effect of nitrogen fixation and plant species on ammonium and amino acids soil contents

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Introduction Grass and legume intercropping systems, particularly ryegrass-clover mixed cultures, increase grasslands productivity, due to the clover nitrogen (N) fixation and to the transfer of part it to the companion grass. The objective of this experiment was to determine if N fixation and plant species could modify ammonium and amino acids soil contents.

Materials and methods Two weeks after germination, plants of white clover (*Trifolium repens*) cv. Huia and perennial ryegrass (*Lolium perenne*) cv. Bravo were transferred into pots filled with soil collected from a natural grassland sward in Haras du Pin, Normandy, France. Plants were grown in a controlled environment room and supplied with nutrient solution to achieve nitrate concentrations equivalent to 0 (N0), 50 (N50) or 180 (N180) kg/ha. Control pots were left without any plants in the same conditions to study plant effects on soluble N profiles of the soil. Eighty days after transplanting, 4 replicate pots for each treatment were harvested. Samples of 10 g homogenised soil were extracted using KCl 0.5M to determine ammonium and amino acids contents. Only significant differences ($P < 0.05$, Anova or Kruskal-Wallis tests) are discussed.

Results Ammonium concentration was high in the clover rhizosphere and decreased with the nitrate fertilisation rate (Table 1). This can be related to an inhibition of N fixation by high N levels as observed by numerous authors. In case of ryegrass, ammonium rhizospheric concentration was low and increased with N fertilisation. As for ammonium, amino acids concentration in the clover rhizosphere decreased with the nitrate fertilisation rate. Glycine (Gly), serine (Ser) and glutamate (Glu) were the major amino acids found in the soil solution, while aspartate (Asp), asparagine (Asn) and arginine (Arg) where also recovered in significant amounts (Figure 1). Comparison of the free amino acid profiles of non-rhizospheric soil and soil from clover or ryegrass rhizosphere suggests that the soil was not influenced by the presence of the roots or by the plant species.

Table 1 Ammonium and amino acids soil contents

	Ammonium (mM)			Amino acids (µM)		
	N0	N50	N180	N0	N50	N180
Clover	1.79	0.41	0.26	69	37	28
Ryegrass	0.10	0.17	0.74	38	19	40
Mixture	0.27	0.10	0.17	36	32	31

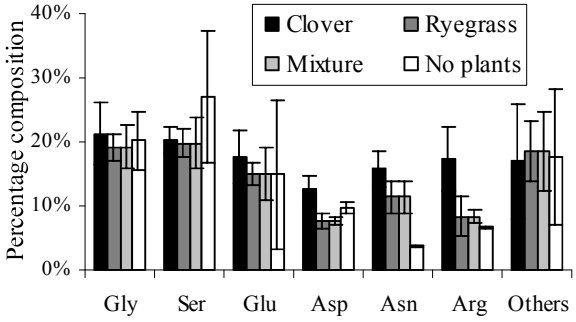

Figure 1 Effect of plant species on amino acids soils profiles

Conclusions There was a significant effect of N fixation and plant species on ammonium and amino acids (specially for clover) soil pools. However, no effect was observed on soil amino acids profiles. The low proportion of amino acids compared with the amount of ammonium in the soil solution confirms recent data by Jones *et al*. (2004) showing that these compounds do not accumulate in grassland soils because they are turned over very rapidly by the microbial activity. As found by Lipson *et al*. (1999), glycine, serine and glutamate are among the most abundant free amino acids found in soil. In contrast to ammonium, which has a nutrient role for plants, these amino acids could be implied in the selection of rhizospheric bacteria by plants.

References

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