Dynamics of 4-species plant systems over three years at 19 sites across Europe

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Introduction The ability of a community mixed plant species to remain stable over time may depend on a number of factors including the species present , the initial evenness and the climatic conditions . Previous work on grassland mixtures shows that diversity benefits in respect of yield and unsown species are higher when the proportions of four species are relatively evenly distributed (Kirwan *et al .* , 2007) . In this paper we examine results from a multi-site agrodiversity grassland experiment carried out under the auspices of COST852 and assess the development of the dynamics of the experimental 4-species communities over three harvest years . Mixtures that remain somewhat evenly distributed over time may be superior at delivering important ecosystem functions .

Materials and methods A common experiment was carried out over a wide climatic gradient at 19 sites across Europe using four species (two grasses and two legumes) and is described in full in Kirwan *et al .* (2007) . At each site , fifteen experimental communities were established at each of two sowing densities (low being 60% of high) . There were four monoculture communities (one for each species) and 11 four-species communities where the initial proportions of each species was varied ; of these 11 , there were four communities with one dominant species (70% , 10% , 10% , 10%) , six communities with two species dominant (40% , 40% , 10% , 10%) and a centroid with each species equally present (25% , 25% , 25% , 25%) . One of two species-groups was used at each site ; the Mid-European group (ME) with species *Lolium perenne* (G_1) , *Dactylis glomerata* (G_2) , *Trifolium pratense* (L_1) and *Trifolium repens* (L_2) was sown at 14 sites and the Northern-European group (NE) with species *Phleum pratense* (G_1) , *Poa pratensis* (G_2) , *Trifolium pratense* (L_1) and *Trifolium repens* (L_2) was sown at the remaining five sites . A number of harvests was taken at each site over a period of three years and the annual total yield of each of the sown species and of unsown species was recorded .

Results and discussion For the ME group , *Dactylis glomerata* (G_2) became increasingly dominant over the three years and in year 3 it dominated on average 61% of annual harvest [Figure 1(a)] . For the NE group the grasses *Phleum pratense* (G_1) and *Poa pratensis* (G_2) became dominant , and in year 2 and 3 together accounted for more than 60% of annual harvest while the legumes in this group decreased slightly over the three years [Figure 1(b)] . Unsown species increased in the third year in the ME group but remained stable over the 3 years in the NE group .

Conclusions In both groups grasses became dominant over legumes over the three year period , however the relative importance of the two grass species changed over time . In the ME group both grasses were strong in year 1 but G_2 dominated in year 2 and 3 . In the NE group G_1 dominated in year 1 but both G_1 and G_2 were dominant over legumes in year 2 and 3 .

Figure 1 *Annual average percentage of total yield for each of the fours species (G1 ■ ; G2 ▲ L₁ × ; L₂ +) and for unsown species (●) for (a) the ME group and (b) the NE group .*

Reference

Kirwan , L . , *et al .* , (2007) . Evenness drives consistent diversity effects in an intensive grassland system across 28 European sites 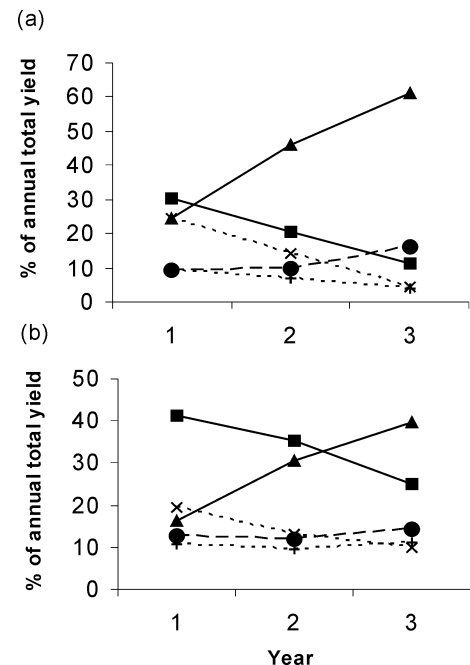. *Journal of Ecology* 95 , 530-539 .