INFLUENCE OF ARABLE CROP TYPE ON EPIGEIC COLLEMBOLA

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1 - INTRODUCTION

In contrast to macroarthropods, relatively little is known about the effects of different arable crops on the abundance and species composition of Collembola. Results have varied considerably within and among studies, giving evidence both for and against effects of crop type, previous cropping history and overall crop rotations on collembolan populations and communities. However, most of the information on collembolan responses to cropping has been derived from soil samples, which may be inefficient at capturing epigeic species.

In the work reported here, Collembola were sampled in nine different crops grown under three crop rotations in England during 1991-1996. The aim was to determine whether particular crops or their combinations positively or negatively influenced populations and communities of epigeic species. Such information could aid biodiversity management in agroecosystems, where Collembola are an important prey resource for predatory arthropods.

TABLE 1 – Farms, fields and crops

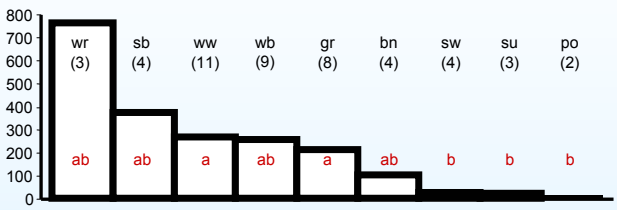
Farm	D (Drayton)		G (Gleadthorpe)			H (High Mowthorpe)		
	Calcareous clay		Stony sand			Calcareous loam		
Field	F1	F5	BA	NK	SO	BU	ON	OS
1991	ww	gr	su	sb	po	wr	bn	bn
1992	ww	ww	sw	wb	sw	ww	ww	ww
1993	gr	ww	wb	bn	wb	sb	wb	wb
1994	gr	gr	po	ww	su	bn	wr	wr
1995	gr	gr	sw	wb	sw	ww	ww	ww
1996	gr	gr	wb	su	wb	wb	sb	sb

bn - spring beans
gr - grass
po - potato
sb - spring barley
su - sugar beet
sw - spring wheat
sb - winter barley
sr - winter rape
sw - winter wheat

3 - RESULTS and DISCUSSION

Principal Components Analysis (Fig. 1) shows that the farms differed in species composition but fields within farms were very similar. Several species had restricted distributions: *E. nicoleti* was found only in field F5 whereas *P. octopunctata* occurred only in field BU. *O. villosa* was found only at Farm D while *E. multifasciata* was absent from all fields at Farm H. Where these species occurred they were abundant in most years, indicating that their restricted distributions were not determined by effects of individual crops.

FIG. 2. Crop ranked by mean Collembola catch 0.46 m^{-2} (number of crops in brackets). Crops not sharing letter codes (a,b) differ significantly (*t*-tests, $P<0.05$)



The community analysis shows that Arthropleona were favoured by a rotation of wheat and grass on a calcareous clay whereas Symphypleona were favoured by a mixed cereals and break crops rotation on calcareous loam. The mixed cereals and root crops rotation on stony sand was unfavourable to most epigeic Collembola. Interpretation at the level of individual crops requires care, as several crops were correlated with farm and soil type. Except for spring barley, winter sown crops had higher collembolan abundance than spring crops (Fig. 2). Highest abundance was in winter rape but this crop was grown only at Farm H. Spring crops were most frequent at Farm G, so significantly lower abundance in spring crops (Fig. 2) could be an effect of farm rather than of crop *per se*. Within-farm comparisons (Fig. 3) confirm that collembolan abundance and taxonomic richness were higher in winter-sown crops, but only differences between farms were significant. The low overall collembolan abundance at Farm G cannot be definitely attributed to the sandy soil, as other studies have shown sandy soils can support high collembolan abundance. An alternative explanation could be that the collembolan fauna at Farm G was already impoverished by previous pesticide use (potatoes and sugar beet in the rotation before 1991 had high pesticide inputs).

Previous studies comparing continuous cereals and mixed rotations have shown that continuous cropping may lead to higher collembolan abundance. In the current study, only grass was grown in consecutive years. Most species which were present in grass at Farm D also occurred in the intervening wheat crops; there was no evidence that overall collembolan abundance differed substantially between grass and wheat.

2 - METHODS

Eight fields, sited at three farms, were suction sampled in summer (May-July) during 1991-1996 to estimate the abundance of epigeic arthropods in different crops (Table 1). To minimise effects of vegetation on sampling efficiency, suction samples included the upper crop foliage and, after excision of foliage, also the soil surface.

The study farms were part of a large-scale investigation of pesticide regime effects on arthropods (the 'SCARAB' Project) which meant that the experimental set-up was not designed primarily to address effects of cropping. Nevertheless, several crops were duplicated sufficiently in space and time to allow their effects on Collembola to be investigated. All crops referred to here were managed under low-input regimes of herbicide and fungicide use, and without any insecticides.

FIG. 1

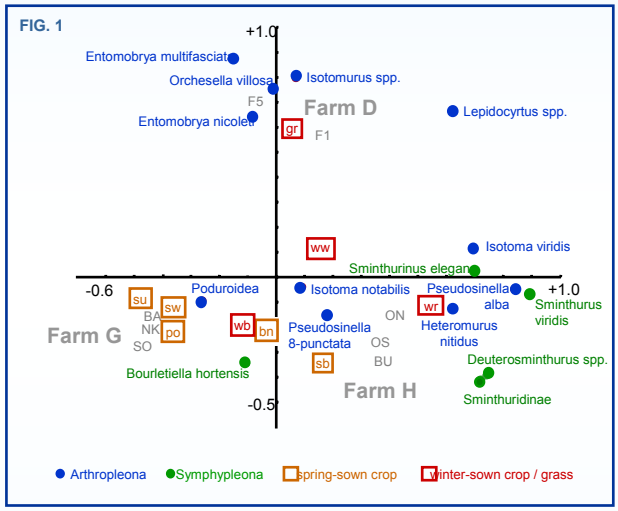
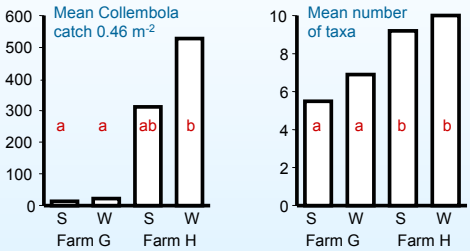


FIG. 3. Within-farm comparisons of spring (S) and winter (W) sown crops. Significant differences are indicated as in Fig. 2



4 - CONCLUSIONS

This study included farms with widely differing species compositions and overall abundance. As a result, farms had a greater effect on the species composition and abundance of Collembola than did crop types. A tendency for winter-sown crops to have higher taxonomic richness and abundance of Collembola than spring crops was observed (but not statistically significant) which would be consistent with adverse effects of spring cultivations and lack of early season vegetation cover; these are factors which are known to negatively affect macroarthropods. It is often assumed that Collembola are ubiquitous in farmland but several species were spatially restricted to induvidual fields. Such restricted distributions, which appear to be independent of cropping, have implications for ecotoxicological studies and warrant further investigation.

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