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Ground flora, small mammal and bird species diversity in miscanthus (*Miscanthus × giganteus*) and reed canary-grass (*Phalaris arundinacea*) fields

T. Semere, F.M. Slater*

Cardiff University, School of Biosciences, Llysdinam Field Centre, Newbridge-on-Wye, Llandrindod Wells, Powys LD1 6NB, UK

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Abstract

Wildlife monitoring of two miscanthus and two reed canary-grass fields in Herefordshire, England was carried out in 2002, 2003 and 2004 to investigate the ecological impact of perennial biomass grass crops on ground flora, small mammals and birds. Quadrats were used to record percentage ground vegetation cover within and around the periphery of each crop. Small mammals were sampled by live trapping using Longworth traps. The common bird census technique was used to monitor populations of birds. Miscanthus fields were richer in weed vegetation than reed canary-grass or arable fields. Bird use of the biomass crop fields varied depending on species. There were considerably more open-ground bird species such as skylarks (*Alauda arvensis*), lapwings (*Vanellus vanellus*) and meadow pipits (*Anthus pratensis*) within miscanthus than within reed canary-grass fields. There was no particular crop-type preference by the small mammal species, but rather a preference for good ground cover and little land disturbance, which was provided by both biomass crops. Ground flora, small mammals and most of the bird species (except open-ground birds) were found more abundantly within field margins and boundaries than in crop fields indicating the importance of retaining field structure when planting biomass crops. The miscanthus work relates entirely to young crops, which may be representative of part of the national crop if large areas are cultivated for rhizomes. The findings from the current project indicate that perennial biomass grass crops can provide substantially improved habitat for many forms of native wildlife, due to the low intensity of the agricultural management system and the untreated headlands.

Keywords: Miscanthus; Reed canary-grass; Biomass crops; Field margins; Birds; Small mammals; Flora; Species diversity; Species abundance; Biodiversity

1. Introduction

It is thought that the decline over the last few decades in arable weeds and their associated invertebrates is due to changes in agricultural practices, such as a reduction in spring sowing of cereals, increased frequency of tillage, hedge removal for field enlargement, a reduction in under-sown grass, simplification of crop rotations and a reduction of mixed lay farming, farm specialisation leading to a loss of mixed farms and increased mechanisation [1,2]. The most widespread effects, however, on both the arable flora and fauna are mainly due to pesticides [2]. Most winter cereals receive about seven different types of pesticide each year, which may include two to three herbicides, two to three fungicides and an insecticide. Perennial biomass grass crops are managed under low input systems [3,4]; and it is likely that they may have a positive effect on biodiversity [5–7]. However, the benefits on biodiversity are not well studied. Few of the literature available on the study of biodiversity in perennial biomass grass crops include birds in switchgrass (*Panicum virgatum*) fields in North America [8,9] and other fauna in miscanthus fields in Germany [10].

Before any perennial biomass grass crop is grown in Britain to a commercial scale of production, it is paramount that environmental impacts are carefully considered in determining its potential to become a major resource for sustainable bioenergy. Currently, biomass grass crops are grown on existing agricultural lands, and

*Corresponding author. Tel.: +44 1597 860308; fax: +44 1597 860381.
E-mail addresses: tzehayes@yahoo.com (T. Semere), slaterfm@cf.ac.uk (F.M. Slater).

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are not replacing land-uses of high ecological value, such as natural forests, semi-natural grasslands or high value agricultural crops. Both of the biomass grass species grown in this study are rhizomatous perennials. Unlike reed canary-grass, miscanthys is not native to Britain. Miscanthus species originate from SE Asia and Africa. Therefore, as a proposed species introduction it should be subject to rigorous ecological assessment before full-scale commercial production.

It is anticipated that replacing ex-arable land with native or introduced new species of perennial biomass grass crops will affect the biodiversity. Agricultural land makes up a big proportion of Britain's countryside; therefore, maximizing its value to wildlife is essential if viable populations of many native elements of the flora and fauna are to be maintained. The main objective of this project was to investigate the ecological impact of introduced biomass grass crops grown in Herefordshire, England. In order to determine how biomass grasses on ex-arable land affect key flora and fauna (both on an annual basis and as the crops develop over the period of study), baseline studies were conducted on a range of organisms: vegetation, ground beetles, arboreal invertebrates, birds and small mammals. Since it is not possible to monitor all species and their abundance, these indicators were chosen to represent a wide-ranging group of organisms. The remit for this project was to monitor major groups for which widely accepted protocols already existed. Indicators of biodiversity chosen in this study were based on ADAS's review of methodologies for future ecological monitoring in energy crops [11]. This paper deals with ground flora, small mammal and bird species.

2. Study sites and methods

2.1. Study sites

The study was carried out during 2002–2004 at four commercial farms in Herefordshire in the west of England. These were two miscanthus (M site 1 and 2) and two reed canary-grass fields (RCG site 1 and 2). A detailed history of the land under study including site location, soil type, soil pH, slope, aspect, exposure, date of planting and nitrogen:phosphate:potassium (N:P:K) prior to planting is presented in Table 1.

2.2. Site selection

Selection of sites (and their total numbers) was dependent upon the availability of sites, the quality of the crop stands and funding for the work. For example, all reed canary-grass sites were chosen, and two miscanthus sites were chosen out of four available farms. When the project began it was expected that the crops would remain for at least the duration of the study, but the value of the rhizomes was such that they were lifted before crop maturity, a factor over which we had no control. The miscanthus crops were grown for their rhizomes rather

Table 1
Details of study sites including site location, total crop area, soil type, soil pH, slope, annual rainfall (RF), date of planting and N:P:K prior to planting

	Miscanthus site 1	Miscanthus site 2	Reed canary-grass site 1	Reed canary-grass site 2
Site location	Ox farm, Shobdon	The Farland's Farm, Lingen	Ox farm, Shobdon	Norman's farm, Stoke Prior
Grid reference	SO 394 598 Lat 52°13′N Long 2°53′W	SO 353 686 Lat 52°18′N Long 2°57′W	SO 412 612 Lat 52°14′N Long 2°51′W	SO 524 558 Lat 52°11′N Long 2°42′W
Altitude	93 m	305 m	93 m	119 m
Total area (ha)	7.0	4.1	3.9	1.3
Soil type	Silty loam	Clay loam	Black peat, with clay loam in places	Clay loam
Soil pH	—	6.8	7.9	6.6
Slope	0%	3%	0%	1%
Annual RF*:				
Year 2000	973 mm		973 mm	
Year 2001	766 mm		766 mm	
Year 2002	878 mm		878 mm	
Year 2003	518 mm		518 mm	
Year 2004	785 mm		785 mm	
Planting date**	24 April 2002	30 March 2000	17 June 2002	April 2000
N:P:K	5:2:2	—	−:0.6:1.5	—
Prior to planting	Normal:normal: Normal (adequate levels)		−:60:30 kg ha^{-1} High:v low:low levels	

*Annual rainfall from Ox House rain gauge, Shobdon (courtesy of Corbett family).

**Both miscanthus sites were harvested for their rhizomes (site 1 in April 2004; and site 2 in April 2003) and left to re-generate naturally. Reed canary-grass site 2 at Stoke prior was ploughed up in September 2003, and replaced by another reed canary-grass field at Lingen (which was planted in the Spring of 2003) by a similar sized area, very close to the miscanthus site 2.