



Seeded ryegrass swards allow granivorous birds to winter in agriculturally improved grassland landscapes

D.L. Buckingham^{a,*}, S. Bentley^b, S. Dodd^a, W.J. Peach^a

^a Royal Society for the Protection of Birds, The Lodge, Sandy, Bedfordshire SG19 2DL, UK

^b NIAB, Huntingdon Road, Cambridge CB3 0LE, UK

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ABSTRACT

We experimentally managed silage fields to provide abundant seed as a conservation measure for wintering birds. Buntings *Emberiza* strongly selected seeded ryegrass plots, where they fed predominantly on ryegrass *Lolium* seed and maintained body weights similar to those on high-quality arable wintering habitats. Bunting usage of seeded plots was positively related to *Lolium* seedhead density, peaking at October seedhead densities above 400 seedheads m⁻². Perennial ryegrass *Lolium perenne* swards could only provide one early silage crop (cut by mid-late May) if sufficient seed was to be produced, while Italian ryegrass *Lolium multiflorum* was able to provide two silage cuts and a large seed crop. Mats of lodged seedheads ensured the continuity of seed provision, resulting in high bird usage during late winter, when most seed has been depleted from existing wild bird seed measures. The estimated cost of the measure was comparable to small-plot measures in current English agri-environment schemes. A rotational seeded ryegrass measure should constitute an effective, affordable and widely applicable conservation measure for seed-eating farmland birds in grassland-dominated farmland across NW Europe.

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1. Introduction

The loss of seed-rich wintering habitats, reducing over-winter survival rates, has been an important driver of granivorous bird declines (Robinson and Sutherland, 2002; Peach et al., 1999; Siriwardena et al., 2007). Regional agricultural specialisation has resulted in landscapes dominated by grassland in western Britain, in which granivorous bird species have been subject to high rates of local extirpation (Chamberlain and Fuller, 1999). The intensification of grassland management and the loss of arable cropping, notably cereal stubbles, have greatly reduced the amount of seed-rich habitat available during winter (Evans et al., 2004). Modern agricultural management aims to prevent grassland from producing seed (Hopkins, 2001), and recent large-scale studies have shown that granivorous birds are largely absent from grasslands in winter (Buckingham et al., 1999, 2006; Perkins et al., 2000; Wilson et al., 1996).

A new potential solution to the lack of seed-rich wintering habitat is to allow existing ryegrass (*Lolium*) swards to produce seed. A small-scale pilot study (Buckingham and Peach, 2006) showed that abundant ryegrass seed could be produced on silage fields following early silage harvests. When left *in situ* over winter, the

resulting seed crops attracted high densities of two granivorous bird species: yellowhammer *Emberiza citrinella* and reed bunting *Emberiza schoeniclus* (Red- and Amber-listed, respectively, due to severe population declines (Eaton et al., 2009)). This approach has clear potential value as a conservation measure for birds in grass-dominated areas. It complements existing arable measures available in European agri-environment schemes (e.g. cereal-based whole crop silage, wild bird seed crops, cereal stubbles (Natural England, 2010)), but is easier to implement on livestock farms.

Leaving excess grass foliage *in situ* can result in sward damage (loosely termed “apparent winter kill”), which temporarily impairs grass productivity in the following spring (Hunt et al., 1976; Milne and Fisher, 1993). New grass germinating from the previous year’s seed crop may help regenerate the sward, compensating for yield losses. Three of the four ryegrass plots in our pilot study suffered silage yield losses, though one plot showed an increase in yield probably caused by extensive germination of fallen ryegrass seed (Buckingham and Peach, 2006). Attempts to remove excess grass growth by grazing resulted in large reductions in grass seed and bird usage, negating the value of the seed crop.

This paper describes a replicated experimental study designed to provide comprehensive information on the use of silage fields to provide seed for wintering birds. The study tested whether seeded ryegrass swards were generally valuable to granivorous birds, examined sward features and management factors affecting the utility of swards to birds and measured the effects of a ryegrass

* Corresponding author. Tel.: +44 1767 693651; fax: +44 1767 692365.

E-mail address: david.buckingham@rsbp.org.uk (D.L. Buckingham).

seed diet on bird body condition. Management techniques for producing suitable seed crops were explored and the costs of these measures were measured.

2. Methods

2.1. Management of experimental plots

Twelve dairy farms in the English West Midlands each provided a single trial field, with swards dominated by ryegrass and managed for silage production. Nine of the fields were predominantly late-heading perennial ryegrass (PRG) varieties, with one field under an intermediate-heading PRG mix, one field predominantly Italian ryegrass *L. multiflorum* (IRG) and one field of hybrid ryegrass *L. x boucheanum*. All 12 trial fields had been under grass for at least one year prior to this study (mean 4 years, range 1–11). Fields were selected that provided potentially suitable foraging conditions for a range of open farmland birds, such as buntings and finches (i.e. the fields were at least 3 ha, with low hedge boundaries and located away from major roads, woodlands or tree lines). The presence of alternative seed-rich habitats was not controlled for, but the distance to the nearest alternative seed-rich site was recorded. Two sites were adjacent to cereal stubbles and four had no obvious seed-rich habitats within a 1 km radius.

Three 0.5 ha trial plots were established in each trial field. The plots were positioned so that each had a similar shape, topography and degree of enclosure by field boundary vegetation, quantified using a version of Wilson's Enclosure Index, modified for use in pastoral farmland (Buckingham et al., 2006). The following treatments were imposed at random on the plots during both the 2007 and 2008 growing seasons:

- 1-CUT take a first silage cut, then no subsequent cuts or grazing
- 2-CUT take two silage cuts, then no subsequent cuts or grazing
- CONTROL take two or more silage cuts and aftermath graze the plot.

Management ceased early on the 1-CUT and 2-CUT plots to allow the grass to produce a seed crop. All operations took place at the same time as routine silage management operations on each farm. Each CONTROL plot was managed in the same way as the remainder of the field: all the year's grass growth was removed before the start of winter by aftermath grazing and/or additional silage cuts, preventing seed production. Fertiliser rates and cutting dates followed normal practice on each farm. First cut dates varied between 11 May to 6 June (mean 24 May) and second cut dates between 30 June to 19 September (mean 30 July). Fertiliser was applied to all plots in March/April (mean 111 kg N/ha) and to each plot immediately after it was cut for silage (means: 71 kg N/ha after first cuts, 43 kg N/ha after second cuts).

After closure, 1-CUT and 2-CUT plots were left undisturbed until the following March, when farmers were permitted to remove senescent vegetation to restore the plots to silage production. Farmers chose their preferred restoration management which included mowing with removal of cuttings (6 occasions), mowing without clearance (7), harrowing (4), cattle grazing (1) and no removal of foliage or litter (6). The dates of spring restoration management ranged between 28 February and 10 April (mean 13 March).

Some plots deteriorated during the first year of the experiment and were replaced in the second year (five 1-CUT plots, two 2-CUT plots and two CONTROL plots). The entire trial field was replaced on one farm as productivity had declined across the whole field, independently of the treatments. The other damaged plots were replaced by new plots situated in the same fields or by rearranging

the existing plots. Seven 1-CUT plots, nine 2-CUT plots and nine CONTROL plots received the same management during both years of the study.

2.2. Seed yields and sward structure

The standing crop of grass seed (still on the seedheads) was measured in October to quantify the density of seeds provided for birds at the start of winter. Seed shed from the seedheads was not measured as it became hidden under dense grass swards where it was unavailable to birds. Seed density was measured in a two-stage process. First, densities of *Lolium* seedheads were measured in ten 50 cm × 50 cm quadrats on each plot. Other grass genera were excluded as they occurred at much lower densities (<5% of total) and largely comprised species with seed that was not available to birds (principally *Phleum*, the seed of which is difficult to remove from dense inflorescences). Half of the quadrats were located within 3–5 m of the field boundary and the remainder at least 20 m from the field boundary. Sward heights (four HFRO sward stick measurements, Barthram, 1985) and broad-leaved weed cover were also measured at each 50 cm × 50 cm quadrat. Weed cover (*Rumex*, *Cirsium/Carduus*, *Ranunculus* & *Stellaria*) was measured using a gridded square quadrat of side 0.7 m, subdivided into 49 grid squares of side 10 cm. The number of occupied grid squares (≥25% cover within each grid square) was counted for each weed genus.

The second stage of seed yield assessment involved the collection of *Lolium* seedheads for laboratory-based germination tests. During the October sampling period, ten seedheads (or as many as were present) were collected from each 50 cm × 50 cm quadrat taking care not to dislodge any loose seed. The seedheads were sealed in paper bags, dried (at 20 °C in a fan assisted oven for 24 h) and stored at 5 °C until tested. The contents of each sample bag were broken up into small pieces to thresh out the grass seed before sowing onto wet blotting paper in clear plastic boxes. The sealed boxes were placed in a growth cabinet maintained at 25–30 °C with 8 h of artificial light. After seven days, the viable grass seed had germinated into small seedlings, which were counted. The germination test method was calibrated using a PRG sample of known (96%) germination rate. The germination tests matched this germination rate, so no correction was applied to the results. Multiplying the number of seedlings per seedhead by the measurement of seedhead density provided an estimate of viable seed density within each quadrat. This measurement automatically excluded incompletely formed seeds lacking starch deposits, which are of little nutritional value to birds.

Sward structure and the distribution of seed-bearing *Lolium* spikelets were measured on all 1-CUT and 2-CUT plots during January (2008 and 2009), to examine the role of sward structure in retaining seed and in making it accessible to birds. Circular 3 m diameter sampling plots were randomly placed at 6 locations in each seeded plot, avoiding the margin. In each sampling plot, the percentage cover of five structural categories was estimated: standing seedheads (SH), exposed lodged seedhead mats (EL), concealed lodged seedhead mats (CL) (where grass regrowth made seed unavailable to birds), bare ground (BG) and vegetative grass without seedheads (VG). Within each structural category, 10 randomly selected *Lolium* seedheads were assigned to three classes based on the number of spikelets that still held seed: 0, <5 and >5 seed-bearing spikelets, identified by feeling the spikelets between thumb and forefinger. The seedheads were found to be missing from many culms, so the percentage loss was estimated for each structural category. Densities of fallen spikelets were measured under each sward structure category in two 10 cm × 10 cm quadrats. Combining these data with the October seedhead density data allowed us to estimate the densities of seedheads that

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