PRELIMINARY FINDINGS FROM A STUDY OF SOWN AND UNSOWN MANAGEMENT OPTIONS FOR THE RESTORATION OF PERENNIAL HEDGE-BOTTOM VEGETATION

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ABSTRACT

The methodology and preliminary findings of a three year experiment designed to evaluate the effectiveness of various management options for restoring a botanically degraded hedge bottom are described. Two types of management option are being investigated. The first makes the assumption that by stopping damaging practices, the natural process of succession will restore the perennial vegetation. The second approach involves the removal of existing vegetation using a broad-spectrum herbicide, and its replacement by sown perennial grasses. There are three unsown treatments using the first approach and six sown treatments. The early findings show some significant differences between the relative frequencies of benign perennial grasses, barren brome (*Bromus sterilis*) and annual forbs between treatments. False oat-grass (*Arrhenatherum elatius*) was the most abundant perennial grass in both the unsown plots and the treatments where it was sown in a mixture with other grasses. Secondary succession in the unsown plots has resulted in a change in distribution of some species.

INTRODUCTION

Traditionally hedges and their associated flora have provided a diverse wildlife habitat in an increasingly uniform farm environment. They are an important nesting site for both songbirds and game birds (O'Connor, 1987); an over-wintering refuge for polyphagous predatory arthropods (Sotherton, 1984) and they provide pollen and nectar for other beneficial insects (van Emden, 1965; Fussell & Corbet, 1992). However, hedge-bottom vegetation is now commonly impoverished in terms of species richness and is also often a potential source of pernicious weeds, particularly cleavers (*Galium aparine*) and barren brome (*Bromus sterilis*) (Boatman & Wilson, 1988). There is evidence that damage has been caused by a number of farming practices such as inaccurate fertiliser application, drift of herbicides and cultivation close to the field edges. To make matters worse farmers have attempted to deal with the problem by spraying out the hedge-bottom vegetation with broad-spectrum herbicides (Marshall & Smith, 1987).

This project differs from other studies of management techniques for the restoration of a benign hedge-bottom vegetation (e.g. Smith & Macdonald, 1992), in that it is primarily concerned with the evaluation of different perennial grass species for their effectiveness in excluding annual weeds such as *B. sterilis* and *G. aparine* and in providing over-wintering habitat for polyphagous predators. Yorkshire fog (*Holcus lanatus*) and cocksfoot (*Dactylis glomerata*) were chosen because they have been shown to support high numbers of over-wintering predacious arthropods (Thomas *et al*, 1991); red fescue (*Festuca rubra*) and false oat-grass (*Arrhenatherum elatius*) were chosen because they are natural colonisers of hedgerows and form a dense sward sward which is likely to resist invasion by annual weeds and may also provide a suitable habitat for over-wintering predators. Our aim is to provide farmers with a workable strategy for dealing with hedgerow weeds and encourage natural enemies. Here we report our preliminary findings.

METHODS

Establishment of the experimental site

In October 1991 an experiment was set up at Down Farm, Headbourne Worthy, Winchester (SU 470 336), using a stretch of damaged hedge-bottom vegetation, dominated by *B. sterilis* and *G. aparine*. The hedge itself was reasonably well-maintained. Nine different treatments were prescribed widening the hedge bottom to 2m. These were repeated three times as 2m x 10m plots in a randomised block design along the length of the hedge. All farming practices were excluded from the extended hedge bottom after the field was ploughed in the autumn of 1991, thus regeneration of the vegetation in the unsown treatments was from this time. Sowing was carried out in September 1992 following removal of the existing vegetation with glyphosate. All the treatments were mown biennially in the autumn.

TABLE 1. Treatments

A. Control: No treatment
B. No sowing or herbicide treatment. Mown three times a year (June, July and September) during establishment.
C. One application in December 1992 of mecoprop-P at 1380g a.i. per hectare and quizalofop-ethyl at 0.075g a.i. per hectare.
D. Sown with cocksfoot (*Dactylis glomerata*).
E. Sown with red fescue (*Festuca rubra* ssp. *rubra*).
F. Sown with false oat-grass (*Arrhenatherum elatius*).
G. Sown with Yorkshire fog (*Holcus lanatus*)
H. Sown with a mixture of all four grasses in D - G above.
I. Sown with a mixture of all four grasses and cut three times a year as in treatment B.

Mecoprop-P was applied for selective control of *G. aparine*, and quizalofop-ethyl for selective control of *B. sterilis* (Boatman, 1992 and unpublished data). Seed rates were determined according to the weight of the seed so that roughly an equal number of seeds was sown for a given area. Thus *F. rubra* and *D. glomerata* were sown at 10g (2g) m^{-2}, *H. lanatus* at 5g (1g) m^{-2} and *A. elatius* at 20g (5g) m^{-2}. Amounts in brackets are the quantities sown in the mixtures. By March 1993 it was apparent that, with the exception of *A. elatius*, there was poor establishment of all the sown treatments in the first block.

It was necessary to have reasonable establishment of all the treatments to ensure sufficient replication for assessing over-wintering arthropods, therefore it was decided that all the sown treatments in that block should be raked over and re-sown at half the original seed rate. This was carried out at the end of March 1993.

Botanical assessments

Botanical assessments were made of the unsown treatments in June 1992 and of of all the treatments in June 1993. A comb-shaped rectangular quadrat, 2m x 0.5m, was placed in a transect across each plot, perpendicular to the hedge, at 2m intervals, thus sampling five transects per plot. The "comb" was divided along its length by prongs into 40 sections of 5cm x 10cm. Presence or absence of each species was recorded, giving a value of 0 or 1 per section, and a total of 0 - 40 per transect.

Mean percentage frequencies of perennial grasses of the species sown, *B. sterilis* and annual forbs were compared using a two-way ANOVA of arcsine transformed data followed by the Tukey test. Confidence limits for the percentage frequencies of different grass species found in the sown mixtures were derived from the binomial distribution.

RESULTS

Mean numbers of species found in the unsown treatments are shown in Table 2. There was a small, non-significant change in species number between the two years. Perennial and annual species were found in roughly equal proportions in the two years. In the unsown treatments *A. elatius* was by far the most abundant perennial grass in both years. In 1992 it was mainly limited to within one metre from the hedge base, however, in 1993, it had spread across the plots. The opposite was true of *B. sterilis* which had an extensive distribution in 1992, but by 1993 was confined to the outer half of the plots and had been almost eliminated from the herbicide treatment. The distribution of perennial grasses and *B. sterilis* was different where the vegetation had been removed and re-sown, represented by the sown mixture (Treatment I) in Figure 1.

TABLE 2. Mean number of species per plot found in unsown treatments

(Standard errors of the means are given in parentheses)

Treatment	1992	1993
Control	19.3 (2.89)	15.7 (0.58)
Frequent cutting	18.0 (0.58)	15.3 (1.20)
Selective herbicide	20.3 (3.18)	18.0 (1.16)

Significant differences were found between treatments in the frequency of desirable grasses, *B. sterilis* and annual forbs (Figure 2), however in the case of *B. sterilis* and annual forbs there was also a highly signicant block effect ($P<0.01$).

In both treatments sown with a mixture of grasses the percentage frequency of *A. elatius* was significantly higher than that of *F. rubra* (P<0.05), which was significantly higher than that of the other two species (P<0.01). In the uncut mixture (Treatment I) percentage frequency of *D. glomerata* was significantly higher than *H. lanatus* (P<0.05).

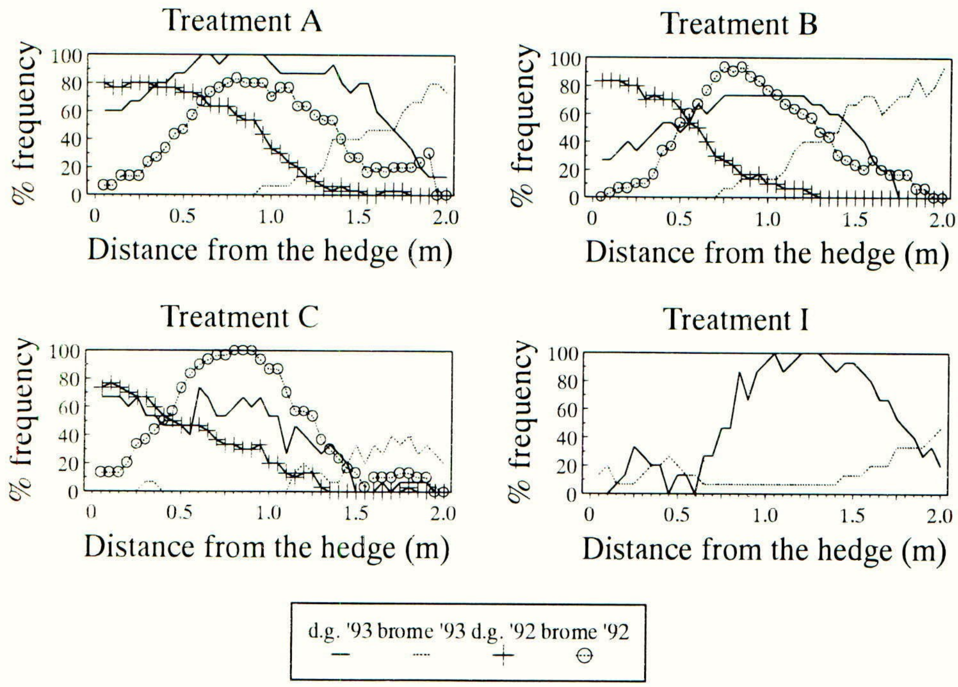

FIGURE 1. Changes in the distribution of selected* perennial grasses (p.g.) and *B. sterilis* (brome) in Treatment A (control), Treatment B (frequent cutting) and Treatment C (selective herbicide) between 1992 and 1993, and in Treatment I (sown grass mixture) in 1993. * *A. elatius*, *F.rubra*, *D.glomerata* and *H.lanatus*.

DISCUSSION

Successional change in the control and unsown cutting treatment resulted in an increase in both frequency and distribution of selected perennial grasses. Dominance of these plots and the treatments where a mixture of grasses was sown by *A. elatius* is in agreement with findings in other work (Marshall, 1990; Grubb, 1982; Mahmoud & Grime, 1976). This grass species possesses many characteristics of dominance (Grime, 1977; 1987): greater height, a root storage system ensuring that resources are available for rapid reallocation at the start of the growing season, the development of dense tussocks that exclude other species and an ability to spread and invade. In consequence *B. sterilis* was reduced in both frequency and distribution in these unsown plots with a trend towards a reduction in species number, although with the annual/perennial ratio unchanged. The hedge grew considerably between 1992 and 1993, and this was the most likely reason for the reduced grass frequency directly beside the hedge.

It would be unwise to draw any conclusions regarding the herbicide treatment at this stage, although in other experiments selective herbicide use has been shown to be effective in controlling *B. sterilis* and *G. aparine* in field margins (Boatman, 1992).

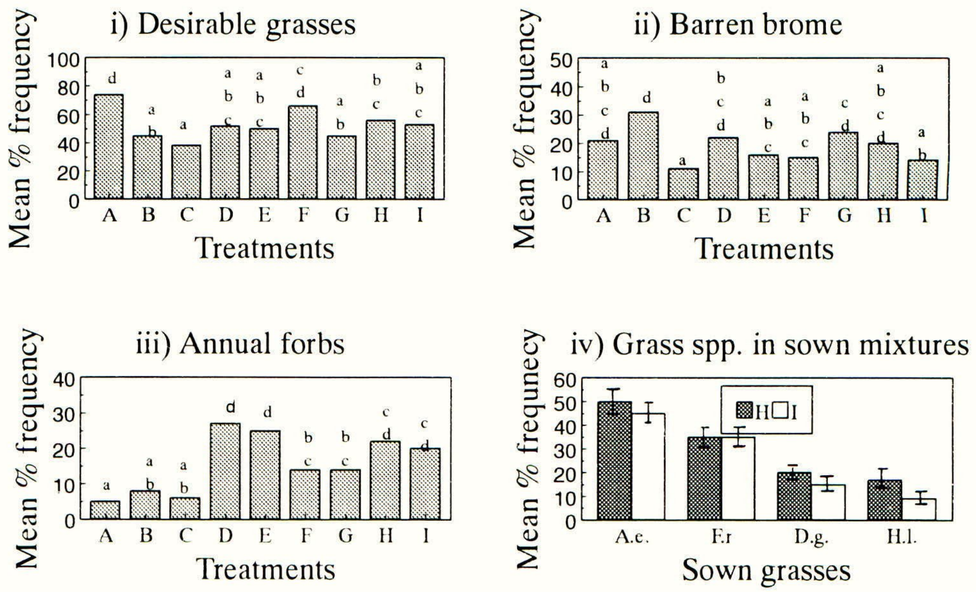

FIGURE 2. i),ii) and iii) Mean percentage frequencies of plant types found in the different treatments (see Table 1). Those with the same letter showed no significant difference (P>0.05) by two way ANOVA of transformed data followed by Tukey test. iv) Mean frequencies of different grasses found in treatment H (sown mixture with frequent cutting) and Treatment I (sown mixture with annual/biennial cut). Error bars indicate 95% C.I.

The best perennial grass establishmant was by *A. elatius* in the control and in the treatment where it was sown as a pure stand. The competitive ability of *A. elatius* is greatest in an undisturbed environment (Grime, 1987), hence its poor performance where there was frequent cutting in treatment B. Despite our view that we had chosen a hedge with a reasonably uniform vegetation and structure, there were highly significant block effects in terms of weed control. Re-sowing of the first block, slope of the field and differences in the original vegetation were probably all contributory factors. As we expected, there was a higher frequency of annual forbs in the sown than unsown treatments in this first year of establishment, as these were able to establish at the same time as the grass seedlings.

Although only tentative conclusions can be drawn from these preliminary data, we have demonstrated the competiveness of *A. elatius* in a hedgerow environment. We have also shown that non-intervention can be an effective, if slow, option for restoration of perennial hedge-bottom vegetation. However, there may be some trade-off between species diversity and weed control (Smith & Macdonald, 1992); the prevention of weed invasion by competitive grasses is likely to mean that other benign and beneficial perennial plants will be unable to establish and compete.

ACKNOWLEDGEMENTS

We would like to thank Simon Brown of Meyrick Estates for the use of his land. We would also like to thank Dr Tom Sherratt for statistical advice and criticism of the manuscript. This project is being funded by SERC in collaboration with the Game Conservancy Trust, Fordingbridge.

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