

# Sward enhancement: diversifying grassland by spreading species-rich green hay

**Sward enhancement refers to management techniques which aim to increase the botanical diversity (mainly the wildflower component) of species-poor grassland. Such work can be funded under Environmental Stewardship, in particular Higher Level Stewardship. Spreading species rich green hay is one method of sward enhancement. Other techniques of oversowing, slot seeding and planting pot-grown transplants and plugs are described in separate notes.**

## Key points

Both donor and receptor sites for green hay must be carefully selected.

The receptor site should be prepared prior to spreading to achieve a short sward with 50% bare ground.

Use green hay spread within a few hours of collection.

Hay must be bedded in after spreading (for example, by trampling with stock).

Subsequent site management is required.

## Introduction

Not all grassland is suitable for enhancement. The main requirements include low soil fertility and low/no weed burden.

Enhancement methods usually involve disturbance to the sward. The benefits of enhancement must be balanced against the risk of erosion or damage to other features for example, buried archaeology or bird interest.

Hay spreading is unlikely to be suitable where visible archaeological features are present. If in doubt consult your historic environment advisor.



Mown hay meadow in Lower Derwent Valley NNR

For more information see Technical Information Note TIN061 - *Sward enhancement: selection of suitable sites* and TIN062 - *Sward enhancement: choice of methods*.

## Sward enhancement: diversifying grassland by spreading species-rich green hay

The term green hay refers to herbage cut at or just before the hay stage, which is collected without prior wilting or turning and spread immediately on the receptor site. If collected from species-rich grassland and used correctly on the right sites it can be a very effective method of sward enhancement.

The main advantages of using green hay are that it is usually cheaper than purchasing commercial seed and it is a good means of ensuring that fresh seed from a local source is used. In addition a wider range of species may be contained in green hay than is available as seed.

Green hay, rather than conventional dry hay, is recommended because a much higher proportion of the seeds remains in the flower heads. Research has found that a broad range of species is present in green hay, including early flowering species such as cowslip *Primula veris*. There are also indications that using green hay is a good method of promoting colonisation by orchids.

In dry hay, many seeds are shed in the processes of drying and collecting, and what remains is mostly grass seed rather than wildflower seed. Spreading dry hay may introduce a few wildflowers (especially if the hay is carefully handled and fresh), but it is unreliable and it is not considered suitable as the main method of sward enhancement.

To be successful, the technique of spreading green hay requires very careful organisation. The receptor site must be ready to receive the hay when the donor site is cut. Green hay cannot be stored for more than a few hours before it heats up. Any heating will threaten the viability of the seeds. Once collected the green hay must be immediately transported to and spread on the receptor site.

Research to date has focused on the use of green hay to enhance hay meadows, and the method is probably easier to undertake on meadows than pastures. However, there are also encouraging results from experiments on the use of green hay to diversify pastures.

### Terminology

Green hay	Herbage cut at or just before the hay stage, which is collected immediately without prior wilting or turning.
Donor site	Grassland used as the source of green hay.
Receptor site	Grassland on which the green hay is to be spread.

### Donor site

#### Choice of site

Donor sites for green hay should be grassland with the following characteristics:

It should be in the same locality as the receptor site and support a range of the target species that are absent or scarce on the receptor site.

Site characteristics should be similar to the receptor site, for example, soil type, soil pH, hydrology and management (meadow/pasture).

It must be free from pernicious weeds such as spear thistle *Cirsium vulgare*, ragwort *Senecio jacobaea* and broad-leaved dock *Rumex obtusifolius*.

Highly competitive species such as Yorkshire fog *Holcus lanatus*, white clover *Trifolium repens* and creeping buttercup *Ranunculus repens* should not form a major part of the sward.

It must be physically possible to cut and collect the vegetation. Steep banks may not be suitable.

It must be large enough to supply sufficient green hay for use on the receptor site. **As a guide, material cut from 1 ha should be sufficient to spread on to 3 ha.**

Possible donor sites include meadows, banks, road verges and churchyards. It is important to avoid damage to nesting birds, invertebrates and plants of interest on donor sites, particularly on sites that are not normally managed by cutting.

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It is not necessary in every case for the donor site to be species-rich. Where the receptor site is in the early stages of restoration, it may only be necessary for the donor site to contain a range of species typical of semi-improved grassland and/or which are relatively easy to establish.

It is thought that some of these (for example, red clover) are 'facilitator species' which can speed up subsequent colonisation of species that are more difficult to establish. It will often be useful for the donor site to contain yellow rattle which parasitizes more competitive species.

Further information on choice of target species is given in TIN050 – *Selecting indicators of success for grassland enhancement*.

For advice on what is an acceptable donor site for a particular hay spreading operation, contact your Natural England Adviser. Permission to take green hay will be required from Natural England if the site is a SSSI or is in an agri-environment scheme agreement.

### Frequency of use

Many grassland species typically have very poor soil seed banks, as they rely on rapid germination in the autumn or spring following seed shedding.

Green hay removes more seed than dry hay and risks reducing the diversity of the donor site. Therefore, it should not be used too frequently. As a guide, green hay should be taken from no more than one third (but preferably one fifth) of a site in any one year, and a different area should be cut each year.

### Timing of green hay collection and spreading

The sward must be left uncut and ungrazed for 8 to 12 weeks prior to collecting green hay. This will allow the plants to flower and set seed.

Where the donor site is a traditionally managed, species rich hay meadow it should be cut at the usual time for that site (usually mid July to early August). Most plants in those meadows will have completed flowering and seed development by

hay cutting time as a consequence of years of such management.

In pastures plants flower and set seed over a longer period and it is more difficult to collect the full range of species with a single cut. It may be better to try a later cutting date (for example, late August/early September) as this will allow the seed of late flowering species such as harebell (*Campanula rotundifolia*) to be collected.

Cut herbage should not be wilted or turned and should be collected as quickly as possible, certainly within 24 hours of cutting.

### Receptor site

The success of hay spreading depends on the presence of gaps in the sward which are large enough for seeds to germinate and establish free from competition. Seeds must land and then be pressed into the bare soil in the gaps, with sufficient moisture to germinate and sustain them.

### Weed control

All pernicious weeds present in the sward should be controlled prior to ground preparation. Any application of herbicide should be by spot treatment or weed wiping to avoid damaging non target species.

Spear thistle, ragwort and other weeds with wind-blown seeds should be controlled where they occur on adjacent areas, as they can quickly invade once the sward has been opened up.

### Ground preparation

In the majority of cases, ground preparation will be required prior to hay spreading. Spreading hay onto an undisturbed sward is extremely unlikely to be successful. Seed may fail to come into contact with the soil and die, and any seedlings which germinate may be out-competed by the existing sward.

The starting point is a short sward, created by cutting (with cuttings removed) or grazing. The aim is then to create 50% bare ground, using livestock (the 'hoof and tooth' method) or machinery. This may seem drastic but research

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and experience has shown this to be necessary to reduce competition from the existing sward which can occur rapidly. For example, within a few months, or even weeks the sward will recover and leaving very little bare ground to remain for seedlings to establish into.

Where livestock are used to create bare ground, cattle are most effective as their hooves more easily break up the sward. Sheep can also be effective on damp ground. As a guide there should be frequent gaps of at least 10 cm in diameter.

Where livestock are unavailable, or where the ground is too dry for them to be effective, bare ground can be created using a power harrow or set of discs.

Mechanical sward disturbance may release nitrogen from the soil and stimulate herbage growth which should be controlled – see section on subsequent management. It may also stimulate the weed seed bank, so it should only be undertaken on sites with little or no weed burden. In a few cases, notably in upland hay meadows, there may be sufficient bare ground and soil moisture following the hay cut for seed to be sown without further ground preparation. However, such cases are likely to be rare.

### Spreading the hay

Once the cut material has been collected from the donor site, it must be transported to and spread on the receptor site on the same day - ideally within an hour or two. It is essential that it does not heat up.

The hay should be spread thinly and evenly so that it does not create a mulch which will inhibit seed germination. The sward should be visible beneath the hay.

Leave the hay for at least one week in dry weather, or three weeks in wet weather, to allow seed to fall. After this period allow stock (ideally cattle) to graze the site, and trample out and bed in the seeds. Alternatively, roll the site lightly.

Remove the hay if it is smothering the sward. However, this is unlikely to occur if hay is spread in the recommended amounts.

### Successive hay spreading

Where the receptor site is in the early stages of restoration, and particularly where the donor site is itself not species-rich, it is likely that hay-spreading will need to be repeated.

On more advanced sites, if hay spreading has been undertaken correctly using a species-rich donor site, it should not be necessary to repeat the operation. Major disturbance to the sward within at least the first 2 years should be avoided, to allow plants to establish.

Some of the introduced species may take several years to appear in the sward so the success of hay spreading should not be judged too soon.

## Methods of collecting and spreading green hay (which have been used successfully)

### Large areas

Use a direct cut forage harvester, discharging into a trailer or muck spreader. Spread the herbage with the muck spreader, or fork it out of the trailer.



Spreading green hay by muck spreader

Cut with a mower. (A mower conditioner should not be used as this will encourage seed drop at



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the donor site.) There are several methods that can be used to spread the hay:

Fork the herbage into a trailer and fork it out onto the receptor site.

Gently row up the herbage, then bale it with a round baler into loose bales. Bales should be tied or netted but not wrapped. (Note that green bales will be considerably heavier than bales of dry hay. To make spreading easier, the thickness of the layers forming the bales can be reduced by decreasing the forward speed of the baler whilst maintaining PTO speed.) Spread the bales by:

Unrolling and forking them out by hand.

Unrolling them, then spreading them with a hay bob/tedder.

Using a straw chopper.

Using a muck spreader.

Gently row up the herbage, then collect it with a forage harvester discharging into a muck spreader or a trailer. Spread the chopped material with the muck spreader, or fork it out of the trailer.

### Small areas

Cut the vegetation with a brush cutter or power scythe. Then either:

Fork the herbage into a trailer and fork it out onto the receptor site.

Row up the herbage and bale it with a mini baler. Unroll the bales and fork them out onto the receptor site.

### Subsequent management

Slugs can devastate wildflower seedlings. Following hay-spreading slug populations should be carefully monitored and slug pellets used where necessary, in accordance with statutory instructions and directions for use on the product label. For land in agri-environment scheme agreements, prior approval will be needed from your Natural England adviser.

In the period immediately after hay spreading (usually July - November), the sward should be kept short so that light can aid germination. This is best done by short periods of intensive

grazing. Alternatively the sward can be cut and the cuttings removed. Prolonged grazing should initially be avoided in order to reduce the risk of seedlings being selectively grazed.

In the first spring, it may be necessary to cut or graze the sward to avoid seedlings being shaded out by the existing vegetation. A short period of intensive grazing, or cutting (with the cuttings removed) is recommended. However, this may not be appropriate on all sites and care should particularly be taken to avoid damage to other interests on the site for example, birds and invertebrates.

Any perennial weeds which have colonised should be controlled early on, for example, by spot treatment with herbicide. Any annual weeds are likely to be controlled by the regular cutting or grazing outlined above.

In subsequent years, if the field is to be managed as a hay meadow it should be cut late (for example, after mid July), with swath turning or tedding undertaken to assist seed shedding. The cutting date should be matched to that of the donor meadow, if possible. The use of livestock, particularly for aftermath grazing, is important because they create gaps in the sward and trample in the seed, which helps the introduced species to spread.

Where the field is managed as pasture, plants must be allowed to flower and set seed by reducing the grazing pressure for a period of about eight weeks in the spring and summer.

There should be no use of inorganic fertilisers or widespread application of herbicides.

Commitment to the appropriate long term management is essential if the grassland enhancement is going to succeed and be maintained.

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Technical Information Note TIN035: *Soil sampling for habitat recreation and restoration in agri-environment schemes*

Technical Information Note TIN036: *Soils and agri-environment schemes: interpretation of soil analysis*

Technical Information Note TIN038: *Seed sources for grassland restoration and re-creation in Environmental Stewardship*

Technical Information Note TIN050 *Selecting indicators of success for grassland enhancement*

Technical Information Note TIN060: *The use of yellow rattle to facilitate grassland diversification in agri-environment schemes;*

Technical Information Note TIN061: *Sward enhancement: selection of suitable sites*

Technical Information Note TIN062: *Sward enhancement: choice of methods*

Technical Information Note TIN064: *Sward enhancement: diversifying grassland by oversowing and slot seeding*

Technical Information Note TIN065: *Sward enhancement: diversifying grassland using pot-grown wildflowers or seedling plugs*

This note does not supersede prescriptions in agri-environment scheme agreements. If there is any conflict between the information in this note and your agreement please contact your Natural England Adviser.

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