

Enhancing Arable Biodiversity

Six practical solutions for farmers



Introduction

Farming for food, bio-energy and wildlife



In common with the vast majority of arable farmers, I take great pride in how my farm looks and the wildlife it supports. Nothing gives me greater pleasure than to hear a skylark singing on a spring morning, or to watch a barn owl hunting along a field margin on a

summer's evening. But I also have to run a profitable farm, making its optimum contribution to the ever growing demand for crops for food and fuel.

So, is it possible both to provide an attractive, wildlife-rich countryside, and world-class yields of top quality crops? The clear message from the SAFFIE project is yes, it is.

If we combine intelligent research like this with smart science and the right incentives, farmers can rise to the challenge of providing the country with the food and fuel it needs, and a countryside of which we can all be proud. That is the way ahead.

Peter Kendall
President NFU

Thinking big for biodiversity



As one of the largest contributors arable farmers are the guardians of much of our farmland wildlife, which has specifically adapted to arable landscapes. Managing profitable intensive enterprises brings big environmental

challenges, but also great opportunities. As one of the largest consortiums ever to work on arable biodiversity, SAFFIE had the capacity to think big. It took problems and ideas, developed and tested solutions, then rolled them out to the arable community. I'm particularly proud to see skylark plots in the countryside and options being developed for enhancing grass margins. SAFFIE is a significant milestone on the road towards sustainable rural businesses improving the environment.

Graham Wynne
Chief Executive RSPB



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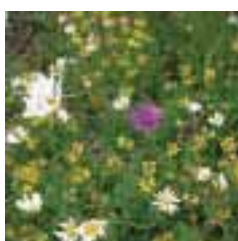
Summary

Arable farmland, accounting for over 20% of UK land area, is a key habitat for biodiversity. Winter cereals occupy almost half of arable land, so improvements that benefit biodiversity in arable fields can potentially have a great impact. The five-year SAFFIE research project, funded by industry and government, involved over 20 partner organisations. It showed that most arable farmers could adopt some common practices if given the right signals, although different solutions are required for different species.



Skylark plots increase chick numbers by up to 50%

Leaving small, unsown areas in winter cereals improves foraging access for adult birds resulting in improved chick survival. There is the potential to increase farmland birds if uptake of skylark plots in Entry Level Stewardship (ELS) can be improved.



Wild flowers in field margins increase beneficial insects by up to 80%

Most field margins are sown with a mixture of low cost grasses. Adding selected wild flowers to these mixtures encourage a wide range of insects including beetles, bugs, butterflies and bumblebees. Adding wild flowers is an extra one-off cost of up to £1,000/ha, so incentives are needed to encourage uptake.



Selective herbicides only in spring, benefit biodiversity within crops

Some weeds have little impact on yield, but provide valuable food and habitat for insects and birds. Using selective herbicides in spring leaves desirable species behind. Specialist advice will be needed as failure to control undesirable weeds can cause substantial yield loss without biodiversity benefits.



Opening up grass margins improves farmland biodiversity

Grass margins are typically left to grow and mown once a year. New approaches, such as scarification or graminicides, create habitats for beetles and other insects. These approaches also encourage native wild flowers and improve access for birds to feed and nest.



Skylark plots with open margins increase farmland birds four fold

Winter cereals and field margins can contain much wildlife and biodiversity. Farmland birds (eg skylark, finches, yellowhammer and other buntings, yellow wagtail and whitethroat) need gaps in which to land and feed on seeds and insects. Dense crops and lush margins are inaccessible to birds. Placing skylark plots in fields with scarified margins sown with grasses and wild flowers improves access and increases farmland bird numbers four fold.

Environmental stewardship increases biodiversity benefits

The SAFFIE research has shown that a few simple measures can significantly improve arable farmland biodiversity. Some of the measures developed by the project are already in environmental stewardship, but all have an economic cost. Appropriate encouragement is needed to ensure greater uptake by farmers of measures in combinations which best deliver arable diversity.



The SAFFIE project

From 2001 to 2006, the Sustainable Arable Farming For an Improved Environment (SAFFIE) project aimed to develop and assess new ways to enhance biodiversity in winter cereals. These crops account for nearly half of UK arable land. The aim was to improve biodiversity and wildlife access within both field margins and crop. Novel management approaches were tested to improve food and habitat for a range of species important to UK farmland biodiversity.

Research programme

Novel techniques	Key	Duration	Sites
Wide-spaced rows & skylark plots	■	2001-03	10
Weed control programmes	▲	2001-05	3
Seed mixtures and novel margin management	▲	2001-06	3
Field-scale assessment			
Integrated treatments	●	2003-06	26

The research phases

- 1. Novel techniques** – tested at three to ten sites.
- 2. Field-scale assessment** – studied the integrated effects of the most promising techniques on 26 farms across the UK.

Monitoring

Basic farming information, eg yields and crop performance was collected along with direct farmer feedback. The groups and species monitored for diversity and abundance included:

Plants	Insects	Birds
Bird's foot trefoil	Bumblebees	Corn bunting
Cocksfoot	Butterflies	Linnet
Common knapweed	Beetles	Skylark
Ox-eye daisy	Harvestmen	Whitethroat
Fescues	Lacewings	Yellowhammer
Timothy	Spiders	Yellow wagtail

The following pages provide more detail of the key studies and results.



Skylark plots

Why it matters

Populations of skylarks, a symbolic bird of open farmland, have declined by 59% since 1970. This has been mainly due to the shift from spring to winter cereals and more intensive grassland management. As a result, skylarks have been 'red-listed' for priority action by UK government and conservation bodies.

Skylarks have difficulty finding food needed for chick survival in dense crops. The birds make fewer nesting attempts in mid-late summer in tall dense wheat canopies than in more open crops.

As winter wheat is up to twice as profitable as spring cereals, a widespread return to spring cropping is not economically sustainable, especially on heavy land. Therefore, new ways are needed to encourage skylarks into winter wheat.



The research

Two techniques to increase access for foraging and nesting were tested on ten farms over two years :

- wide-spaced rows (double normal width)
- two undrilled 'skylark plots' (16-24m² each) a hectare - an approach piloted by RSPB

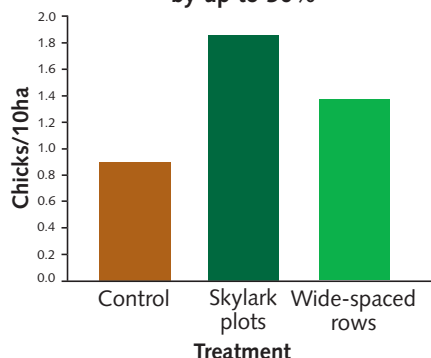
The skylark plots proved most effective and practical. Plots were simply created by lifting the drill out of the ground for 4-6m or by spraying out the crop. The skylark plots were more widely tested on 26 UK farms, and monitored for a further three years.

The results

In the first two years of testing skylark plots, average number of skylark chicks reared increased by up to 50%. Improvement resulted mainly from increased foraging access for adult birds. The plots provided a landing space and improved access to nesting and feeding areas. Wider testing confirmed this benefit, but there was increased nest predation in fields with margins. Therefore, where practical, plots should be placed at least 50m (preferably 75m) from the field margin.

In addition, skylark plots benefited other birds, eg finches and buntings.

Skylark chick survival increased by up to 50%



The economics

Crop loss from skylark plots which occupy only 0.5% of cropped area amounts to about £2/ha. However, there can be other costs. For instance, spraying out plots can be more convenient but cost up to £6/ha. Where weeds, especially black-grass, develop in summer, further spraying may be necessary to reduce weed burdens in future years (£6/ha). In real terms skylark plots can cost £2-12/ha.

Skylark plots are worth 10 points/ha (£10/ha/year) in Defra's Entry Level Stewardship (ELS) scheme.

To find out more:

Best Practice Guide - Skylark Plots
Crop Protection Association (CPA)

Farming for Wildlife - Skylark Plots
Royal Society for the Protection of Birds (RSPB)

ELS Handbook - Skylark Plots EF8
(Defra)

Organic Entry Level Stewardship (OELS)
For simplicity only ELS options have been referenced. Many of the same options are available in OELS.

In-crop biodiversity

Why it matters

Modern wheat production - using efficient cultivation, good nutrition, competitive crops and effective plant protection - affords little opportunity for desirable arable plants to flourish. Yet many species only have a marginal effect on yield, whilst providing valuable food and habitats for insects and birds.

To meet demands for food and fuel, UK wheat area is likely to increase further, and production efficiency remains a priority. The project therefore tested whether in-crop biodiversity could be improved by using different weed control programmes. The aim was to control economically-damaging plants eg cleavers, black-grass and wild oats while leaving desirable weeds (see table).

The research

A range of eight different herbicide programmes were selected to represent current practice or the potential to alter weed spectrum in favour of the more desirable species. These were tested in small plots in wheat at three sites on contrasting soil types for three years. Each of the herbicide programmes was applied to:

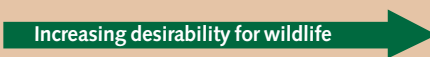
- Conventionally-drilled crops
- Wide-spaced rows
- Wide-spaced rows with inter-row cultivation

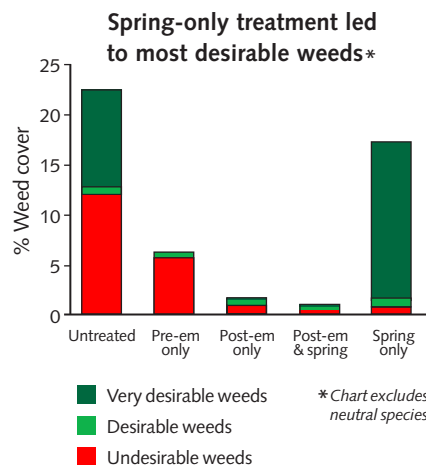
The latter treatment aimed to stimulate spring weed germination.

The results

There was substantial variation between sites and years, and sometimes desirable species increased. Single herbicide applications were better for biodiversity than sequences. A spring-only herbicide (amidosulfuron), was most successful in altering the balance in favour of desirable plants. Leaving some weeds at sites on lighter soils often did not cause yield loss. At the clay soil site most affected by grass weeds, no agronomically acceptable treatment left desirable

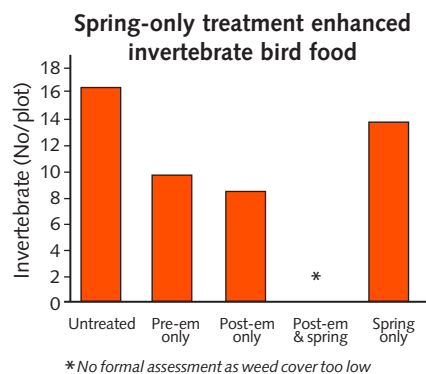
Undesirable	Desirable	Very desirable
Black-grass	Fumitory	Annual meadow-grass
Broad-leaved dock	Groundsel	Black-bindweed
Brome grasses	Mayweeds	Charlock
Cleavers	Mouse-ear	Chickweed
Couch	Pansies	Fat-hen
Creeping thistle	Sow-thistles	Knotgrass
Crop volunteers		Redshank
Wild-oats		Wild radish

All other species recorded as neutral  Increasing desirability for wildlife



species and in one case, a 3t/ha yield loss was recorded.

Wide rows and mechanical weeding had little effect on weed populations. Where desirable plant cover was increased, insect populations were also higher.



The economics

On light soils with low weed pressures, there is potential to reduce herbicide costs (up to £10/ha), achieve acceptable yields and leave desirable plants. Where undesirable weeds are a threat, very high control levels are needed to avoid yield loss and build-up in the seed bank. Implementation of this approach will be site specific and may require expert advice from an agronomist.

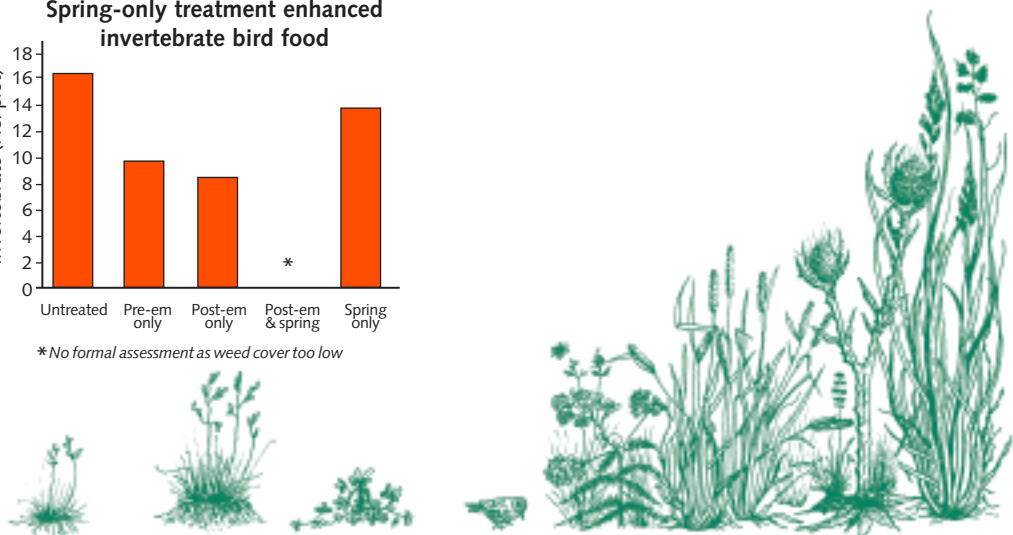
To find out more:

Weed Manager

www.weedmanager.co.uk

Practical Guidelines - Management of Arable Land for Plant Conservation
www.arableplants.fieldguide.co.uk

Discuss weed control programmes with your BASIS registered agronomist.



Margin mixtures

Why it matters

Creating margins introduces new species and diversifies farm habitats.

Seed mixture choice influences:

- initial establishment
- long-term viability
- biodiversity value of plants and insects
- food availability for birds and mammals

Many margins, established under environmental stewardship, are based on low-cost, low-maintenance grasses with limited biodiversity value.

The research

Two wild flower mixtures, with either fine or coarse grasses, were compared with a standard Countryside Stewardship grass mix. These mixtures were tested for five years on three farms. Mixtures were sown in autumn and spring using standard farm practices.

Margins were monitored for openness, vegetation structure, species richness, benefits to insects (eg bumblebees, beetles, butterflies and planthoppers) and use by birds.



Wild flowers increase biodiversity value of margins

The results

Each mix produced different vegetation structures and composition. No one mixture was best for all aspects of biodiversity. Wild flowers always improved margin biodiversity, and some species, eg cocksfoot, ox-eye daisy, yarrow and common knapweed, did well at all sites - others declined rapidly after establishment.

Wild flowers performed best on light, less fertile soils where grass competition was low. Over time, the grass and wild flower species best adapted to local conditions were the most successful. There were no undesirable effects on the crop from the addition of wild flower margins.

Relative performance	Countryside Stewardship	Fine grasses & wild flowers	Coarse grasses & wild flowers
Establishment	██████████	██████	██████
Species richness	██████	██████████	██████████
Desirable annuals	██████	██████	██████
Beetles	██████████	██████████	██████████
Spiders	██████████	██████	██████████
Butterfly & sawfly larvae	██████████	██████	██████████
Bees & butterflies	██████	██████████	██████████
Accessibility for birds	██████	██████████	██████████
Bird species	██████	██████████	██████████

The economics

In practice, farmers should select a blend of fine and coarse grasses, as well as wild flowers that are likely to thrive in their specific conditions, survive for several years, and provide a range of food types.

Establishing standard Countryside Stewardship mixture cost £224/ha. In this experiment, adding wild flowers, increased these costs to £1,200-1,400/ha. The cost of wild flower species that established very poorly was £200-300/ha. In practice establishment costs could be up to £1,200/ha with annual yield losses of £340-600/ha depending on wheat prices. Spread over five years cost of the improved margins equated to £520-840/ha a year.

The 6m buffer strip option on cultivated land (EE3) is worth 400 points (£400/ha/year) and may be sown with wild flowers but no payment is currently available for the extra seed cost. Although not directly

comparable, pollen and nectar margins are worth 450 points in ELS and in HLS the floristically enhanced grass mix is worth £450/ha/year.

To find out more:

Field margins - Guidelines for Entry Level Stewardship in England (HGCA)

Best Practice Guide - Margins Mixtures and Management (CPA)

ELS Handbook - Pollen and Nectar Mixes EF4, 6m buffer strips on cultivated land EE3 (Defra)

HLS Handbook - Floristically enhanced grass mix HE10 (Defra)

Advice is also available from conservation advisors and stewardship scheme guidelines.

Margin management

Why it matters

Grass margins protect hedgerows, waterways and field boundaries.

Uptake of stewardship schemes in the past 10-15 years has led to over 25,000ha of grass margins across the UK.

Most margins, sown with standard grassland stewardship mixtures, are mown annually in late summer, and have limited biodiversity value. Over several years, standard grass margins become dense and rank with little bare ground, preventing germination of annuals and movement of surface-dwelling insects. Bird access is also limited.

The UK Biodiversity Action Plan seeks greater habitat diversity to enhance biodiversity. Therefore, a better understanding is needed of how new and existing grass margins in arable settings can be managed to improve biodiversity.

The research

Trials at three sites were conducted over five years. Two new techniques were tested annually:

- *Scarification with a power harrow in March/April to a depth of 2.5cm to create 60% bare ground across margins.*
- *Graminicide (fluazifop-p-butyl at 0.8L/ha) applied in March/April to suppress more vigorous grass species.*

The aim was to reduce competitive grasses, increase bare ground and improve the value of margins for biodiversity. Both techniques were tested with the three margin mixtures (page 7) and compared with flail mowing to 15cm in March/April.

The results

By the end of the third year, the best results for biodiversity across all mixtures came from scarification. This led to its adoption for the second phase involving 26 farms. Over the full trial, the graminicide treatment also proved

Relative performance	Mowing	Scarification	Graminicide
Species richness	██████	██████	██████
Desirable annuals	██	██████	██
Sward openness	██████	██████	██████
Beetles	██████	██████	██████
Planthoppers	██████	██████	██████
Spiders	██████	██████	██████
Butterfly & sawfly larvae	██████	██████	██████
Bees & butterflies	██████	██████	██████
Accessibility for birds	██████	██████	██████
Bird species	██	██████	██████

to be effective, and each technique provided different biodiversity benefits.

- **Scarification** opened up margins. Bare ground encouraged beetles, annual wild flowers and bird access.
- **Graminicides** limited vigorous grasses and encouraged perennial wild flowers with associated bees and butterflies.
- **Mowing** encouraged grasses and benefited leaf-dwelling insects, eg spiders and planthoppers, but not other species.

The project also found that as scarification was a new technique, farmers were cautious about adopting it.

Scarified margin



Graminicide treated margin

The economics

- Mowing margins - £12.50/ha
- Scarification - £14.50/ha
- Graminicide - £17.50/ha

Similar grass margins in ELS require the 3m next to the crop edge to be mown in August/September and are worth 400 points/ha (£400/ha/year). Neither scarification, nor graminicide use are currently permitted in ELS.

To find out more:

Best Practice Guide - Margins, Mixtures and Management (CPA)

ELS Handbook - 6m buffer strips on cultivated land EE3 (Defra)

Practical Guidelines - Management of Arable Land for Plant Conservation
www.arableplants.fieldguide.co.uk



Encouraging birds

Why it matters

Farmland birds are a Government 'quality of life' indicator and an important measure of the health of the UK countryside. Populations and ranges of many familiar species have halved since 1970.

Changes in farm practice, especially increased winter cropping and removal of hedgerows, have been the main reasons for these declines. New agri-environment schemes, eg ELS, aim to encourage practices that protect and enhance wildlife. Better understanding of the interactions between different measures in the schemes, can help farmers choose the best options for biodiversity.

The research

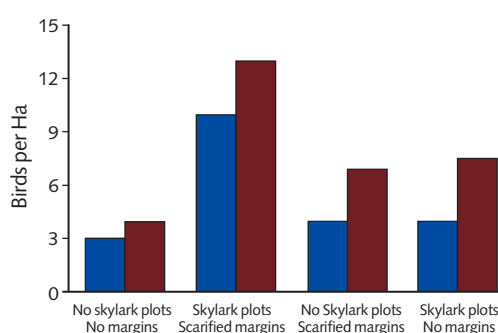
The second phase of SAFFIE research assessed the benefits of integrating the most promising treatments on 26 farms. Comparisons were made between fields with or without skylark plots and with or without scarified grass/wild flower margins.

Farmland birds were monitored in wheat fields of at least 5ha on 26 farms. The impact of the techniques on farmland bird numbers was calculated from field data. Supplementary work, in the last year of the study, also assessed the impacts of predators on ground-nesting birds.

The results

Key results were:

- Integrating skylark plots with scarified grass margins, sown with grass/wild flower mix, gave a three to four-fold increase in numbers of BAP and FBI bird species compared with a wheat crop without margins.



■ Biodiversity Action Plan (BAP) species *

■ Farmland Bird Index (FBI) *

* These include: yellow wagtail, song thrush, whitecoat, linnet and yellowhammer

- Skylark plots and scarified margins both improved bird numbers although bird numbers increased to a greater extent where both treatments were used.
- Better access into crop and field margins benefited birds, rather than an increased food supply.

- Beetles, an important bird food, increased in scarified margins.
- Skylark predation increased where skylark plots and grass margins were in the same field, but predation of species nesting in hedges was not affected. Predation of skylark nests was greatest close to margins, the area where predators most actively seek food.

The economics

There are no additional costs from skylark plots in fields with scarified wild flower/grass margins.

To find out more:

Best Practice Guide - Margins, Mixtures and Management, Skylark Plots (CPA)

Farming for Wildlife - Skylark Plots Royal Society for the Protection of Birds (RSPB)

ELS Handbook - Skylark Plots EF8 (Defra)

Impact of predators

In 2005, predation was identified as a cause of poor nest survival amongst ground-nesting birds in fields with grass margins, particularly when skylark plots were added.

During 2006, infra-red cameras close to skylark nests confirmed predation by various mammals. To protect ground-nesting birds, wherever practical skylark plots should be placed at least 50m (preferably 75m) from field edges, away from the areas where predators most actively seek food and shelter in grass margins, hedges or trees.

Infra-red camera



Skylark nesting in soil crack

Enhancing biodiversity

Making a difference

The SAFFIE project has shown that farmers can adopt a number of simple measures to enhance arable biodiversity. With careful management, focused on specific results, a variety of habitats can be created.

1. Identify biodiversity objectives

- Understand the biodiversity within your farming system.
- Consider the local landscape and historical features.
- Identify important local species and your interests.

2. Manage for biodiversity

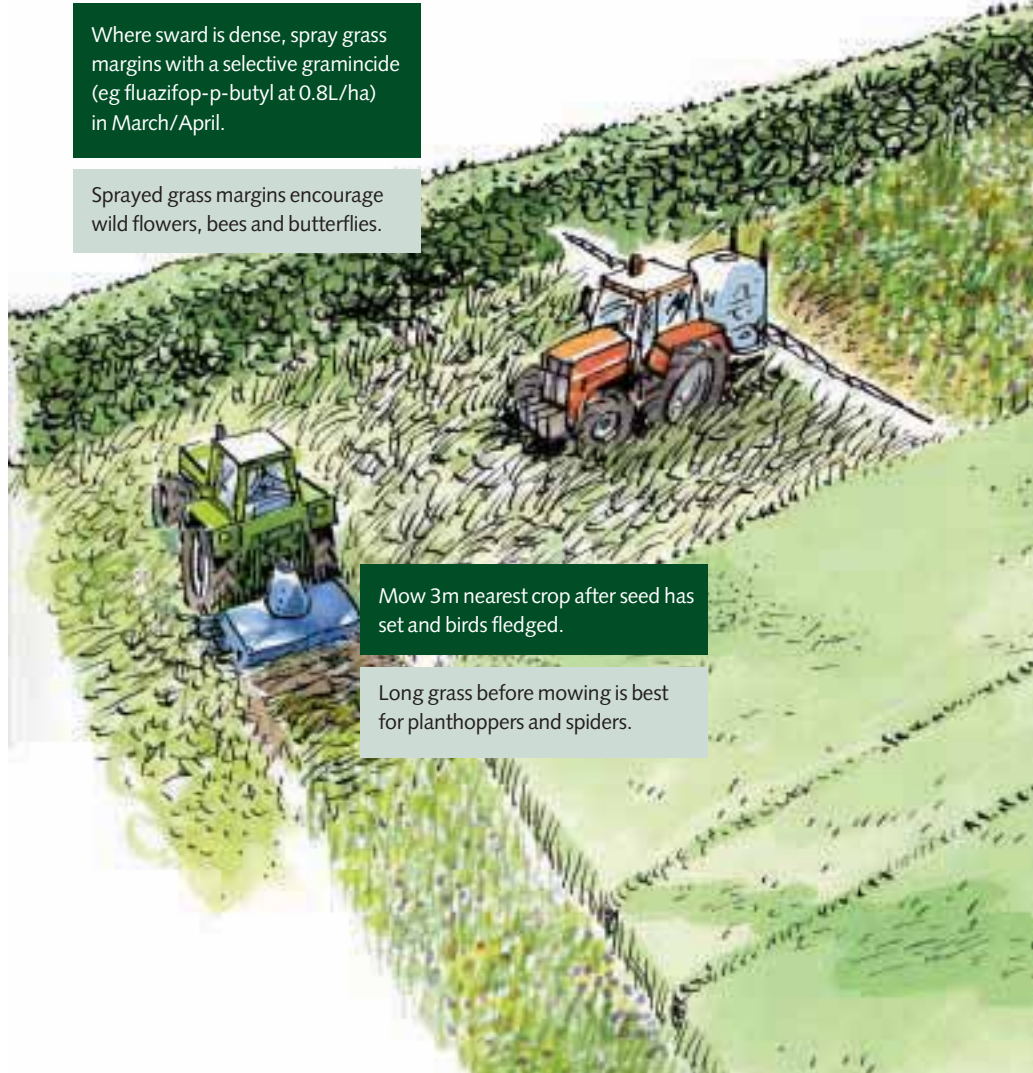
- Make biodiversity an integral part of your farm plan.
- Select species, habitats and management practices that suit your farm and locality.
- Use a variety of habitats and management techniques.

Where sward is dense, spray grass margins with a selective graminicide (eg fluazifop-p-butyl) at 0.8L/ha) in March/April.

Sprayed grass margins encourage wild flowers, bees and butterflies.

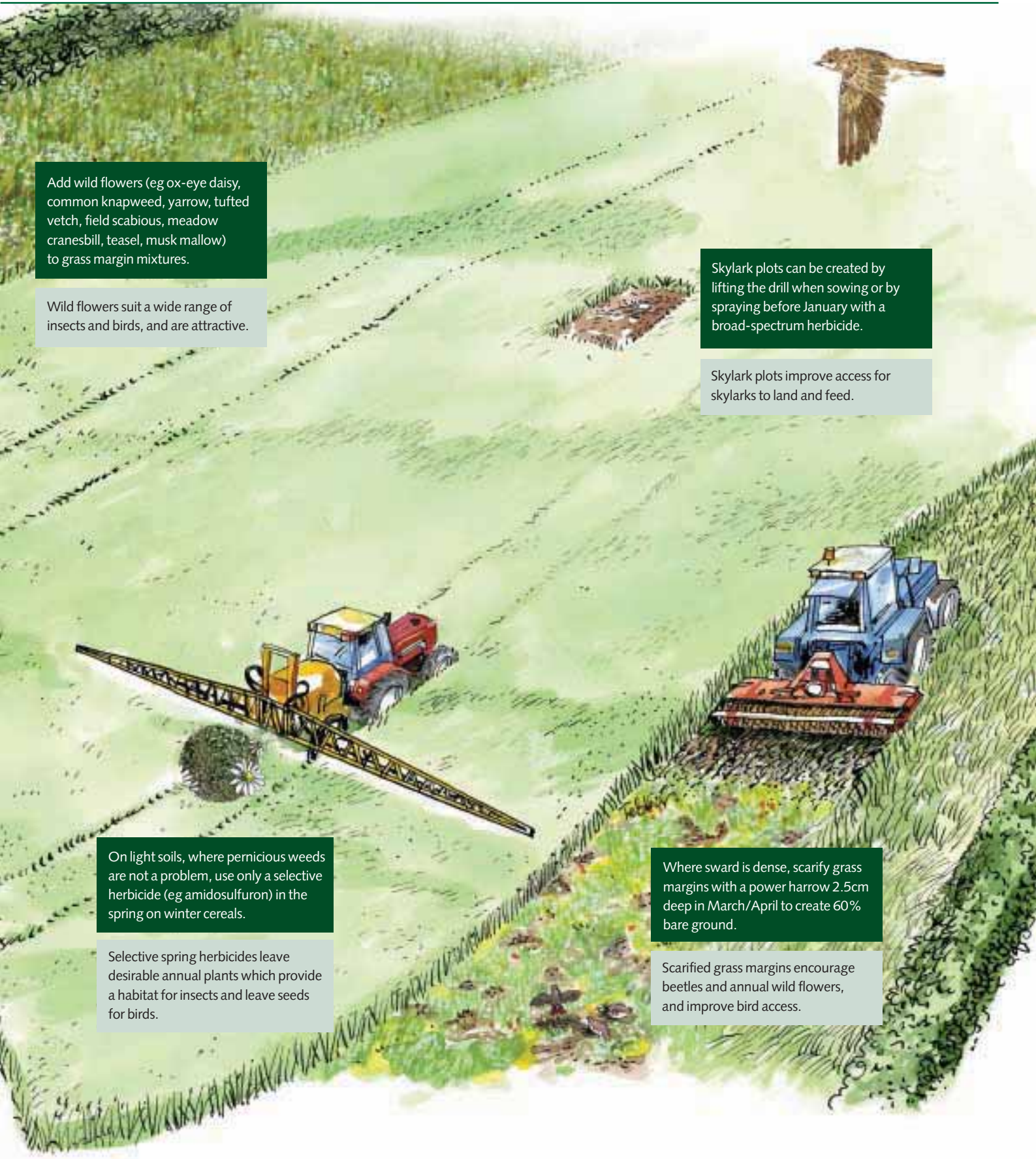
Mow 3m nearest crop after seed has set and birds fledged.

Long grass before mowing is best for planthoppers and spiders.



SAFFIE techniques

	Technique	In ELS	Biodiversity benefits	Best suited to	Avoid
In field	Skylark plots	✓	Skylarks, buntings, yellow wagtail	Large open fields in winter cereals	Siting close to field margins and trees Sites with resistant black-grass
	Selective spring herbicides in cereals	✗	Desirable arable plants, insects	Light soils Known desirable plants Low weed pressure Late-sown crops Spring crops in rotation	Heavy soils Known populations of pernicious or resistant weeds Seed crops
Margins	Wild flower and grass margins	✓	Bees, butterflies, bugs, birds	Field corners Hedgerows Infertile sites	Highly fertile sites Nutrient application in preceding year Areas prone to fly tipping and trespass
	Scarification	✗	Beetles, bird access, bare ground, annual plants	Low populations of pernicious weeds Dense swards Natural England permission required	High seed bank of pernicious weeds Soils susceptible to erosion Very wet sites Cultivating in 2m cross-compliance strip
	Mowing	✓	Planthoppers, spiders, grasses	Thin swards Mowing after fledging and seed set	Mowing 3m nearest the hedge
	Graminicide treatment	✗	Perennial plants, planthoppers, spiders, birds	Dense swards with wild flowers Natural England permission required	Near watercourses Spraying 2m cross-compliance strip Sward with susceptible grasses and no wild flowers



Add wild flowers (eg ox-eye daisy, common knapweed, yarrow, tufted vetch, field scabious, meadow cranesbill, teasel, musk mallow) to grass margin mixtures.

Wild flowers suit a wide range of insects and birds, and are attractive.

Skylark plots can be created by lifting the drill when sowing or by spraying before January with a broad-spectrum herbicide.

Skylark plots improve access for skylarks to land and feed.

On light soils, where pernicious weeds are not a problem, use only a selective herbicide (eg amidosulfuron) in the spring on winter cereals.

Selective spring herbicides leave desirable annual plants which provide a habitat for insects and leave seeds for birds.

Where sward is dense, scarify grass margins with a power harrow 2.5cm deep in March/April to create 60% bare ground.

Scarified grass margins encourage beetles and annual wild flowers, and improve bird access.



This booklet was funded by the above organisations to summarise the SAFFIE LINK project. The full Project Report can be obtained from www.hgca.com (HGCA Project Report 416).



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