FACTSHEET 08/15

Cross Sector

Dr David George, STC, Dr Jennifer Banfield-Zanin, STC and Prof. Felix Wäckers, Lancaster University

Flower power: making the most of flowering seed mixes

Flowering seed mixes can help to address floral scarcity in the farm-scape, promoting farmland biodiversity. Though many available seed mixes target farmland birds, or butterflies and pollinators, they do not necessarily take into account seed mix suitability for natural enemies of crop pests. Their effectiveness in delivering pest control services depends on their composition, as pest natural enemies tend not to use the same flowers as bees and butterflies. This factsheet summarises the advantages to sowing flowering seed mixes, and highlights the importance of careful seed mix selection to optimise pest control returns from them. The resources available for crop-appropriate seed mix design are described. The management of flowering field margins and their use with Integrated Pest Management (IPM) approaches is also detailed.

1. *Picture taken by Paul van Rijn.*

Action points

Why sow flowering seed mixes?

- Areas of sown flowers can qualify for agri-environment schemes.
- Areas of sown flowers can qualify as Environmentally Focused Areas (EFAs).
- Well-designed seed mixes can stack benefits for crop pollinators and pest natural enemies, potentially increasing crop yields.

Will any flowering seed mix do?

- Many options are available, but selecting a general seed mix at random is not always cost-effective.
- Some seed mixes are not suited to agricultural settings, or may contain seeds of potentially pest-promoting plants.
- Nectar and pollen mixes are suitable for butterflies and pollinators, but not necessarily for pest natural enemies.
- Careful selection of a situation-appropriate seed mix optimises returns and minimises risk.

Seed mix management

- Flowering seed mixes are typically sown along field edges, but are also useful in filling unproductive or awkward areas of land.
- Seed should be sown on low-nutrient land, to reduce weed competition.
- Reduce weed seed burden before sowing.
- After sowing, some management is necessary to limit grass growth and maintain sward diversity, usually through mowing.

Can flowering seed mixes fit within an integrated approach?

- Flowering seed mixes are highly compatible with IPM when designed to promote biological pest control. They can provide benefits both when used in combination with other techniques, and as a stand-alone feature.

Background

The scarcity of non-crop floral resources in the modern agricultural and horticultural landscape severely constrains many beneficial insects, resulting in reduced pollination and biological pest control efficacy. By adding non-crop elements and increasing biodiversity in the landscape, a range of important ecological services can be promoted, such as the conservation of rare native species, increased buffering at field edges, and improved pollination and biological pest control, thus optimising crop yield potential.

Flowering seed mixes were originally developed to provide resources for farmland birds, with 'standard' nectar and pollen mixes following in the 1990s to address declines in farmland pollinators. Evidence now suggests that the latter have been at least partially successful, with certain pollinator groups responding well to the ever-increasing areas of farmland sown to 'nectar and pollen' mixes, be these as stewardship options or voluntary measures. Such mixes sit well within the current climate of Common Agricultural Policy (CAP), qualifying as EFAs under Pillar 1 and, as in previous years, as some form of 'nectar and pollen mix' under Pillar 2 agri-environment schemes.

Nevertheless, current use of flowering seed mixes often fails to generate optimum on-farm returns from non-crop areas, as pollinator-targeted mixes do not necessarily provide multiple benefits to pest natural enemies. It follows that whilst boosting on-farm flowers may encourage general conservation, it too often does relatively little to encourage biological control of crop pests.

As part of DEFRA funded HortLINK Project HL0192: 'Perennial field margins with combined agronomical and ecological benefits for vegetable rotation schemes', otherwise known as the Ecostac project, scientists at Lancaster University, Fera and Stockbridge Technology Centre, in collaboration with AHDB Horticulture and other partners, have shown that it is possible to stack and optimise conservation and agronomic benefits obtainable from flowering seed mixes. This project (FV 334), and the related AHDB Horticulture-funded Automated Margin Design project (FV 334a), should make it possible for growers to more easily obtain optimal returns from investment in flowering seed mixes.

Why sow flowering seed mixes?

The benefits of sowing a flowering, rather than a grassy, mix

While grass mixes have been shown to provide benefits to some beneficial insect groups, many pollinators and pest natural enemies require or benefit greatly from access to floral resources. Even where they are not absolutely required, they may still benefit pest natural enemy performance by increasing longevity, activity and reproduction. Provision of appropriate flowering species in agricultural landscapes can therefore greatly improve how well beneficial insects perform, both to pollinate crops, and to manage pests. Consequently, to get optimum returns from beneficial insects in terms of the 'ecosystem services' they provide, it follows that flowering seed mixes are typically considered the best option.

Direct benefits

As long as certain criteria are met, flowering seed mixes can comply with a range of current agri-environment scheme options (Table 1). Areas sown with these mixes can be included as EFAs under the new CAP, even qualifying for both agri-environment scheme and EFA payments simultaneously, though in these cases agri-environment scheme payments are reduced (Table 1).

Indirect benefits

If seed mixes are carefully designed, evidence suggests that they are capable of promoting pollinators and pest natural enemies simultaneously (AHDB Grower, February 2015). When tested as part of the Ecostac project across a crop rotation, use of flowering field margins led to yield increases at crop sampling sites nearer to these margins in three of the four crops grown (cereals, peas and cabbages). Work elsewhere supports these findings and has recorded reduced pesticide use where margins were designed to promote pest natural enemies (van Rijn *et al* 2008). It should be noted, however, that as a biological system such returns from flowering seed mixes cannot be guaranteed year-on-year, or in all crops.

Table 1. Agri-environment scheme options (2015) where the seed mixes used could theoretically return multiple benefits to pollinators and pest natural enemies. Information obtained from gov.uk/countryside-stewardship-grants

Option	Payment if not EFA	Payment if EFA	Brief description
Nectar flower mix (AB1) Mid & Higher	£511/ha	£107/ha	At least four nectar-rich plants and at least two perennials. Use wide margins and big blocks between 0.25ha and 0.5ha. Sow at 12kg per ha.
Flower rich margins and plots (AB8) Mid & Higher	£539/ha	£209/ha	The seed mix should contain both grasses and perennial flowering plants. Wide margins and big blocks specified. Sow at 20kg per ha.
Legume and herb-rich swards (GS4) Mid & Higher (with other conditions met)	£309/ha	–	Minimum 10% cover of red clover and an additional 10% cover of other legumes, herbs and wildflowers. At least five species of grass, three species of legume (including bird's-foot trefoil) and five species of herb or wildflower. Can be rotated.

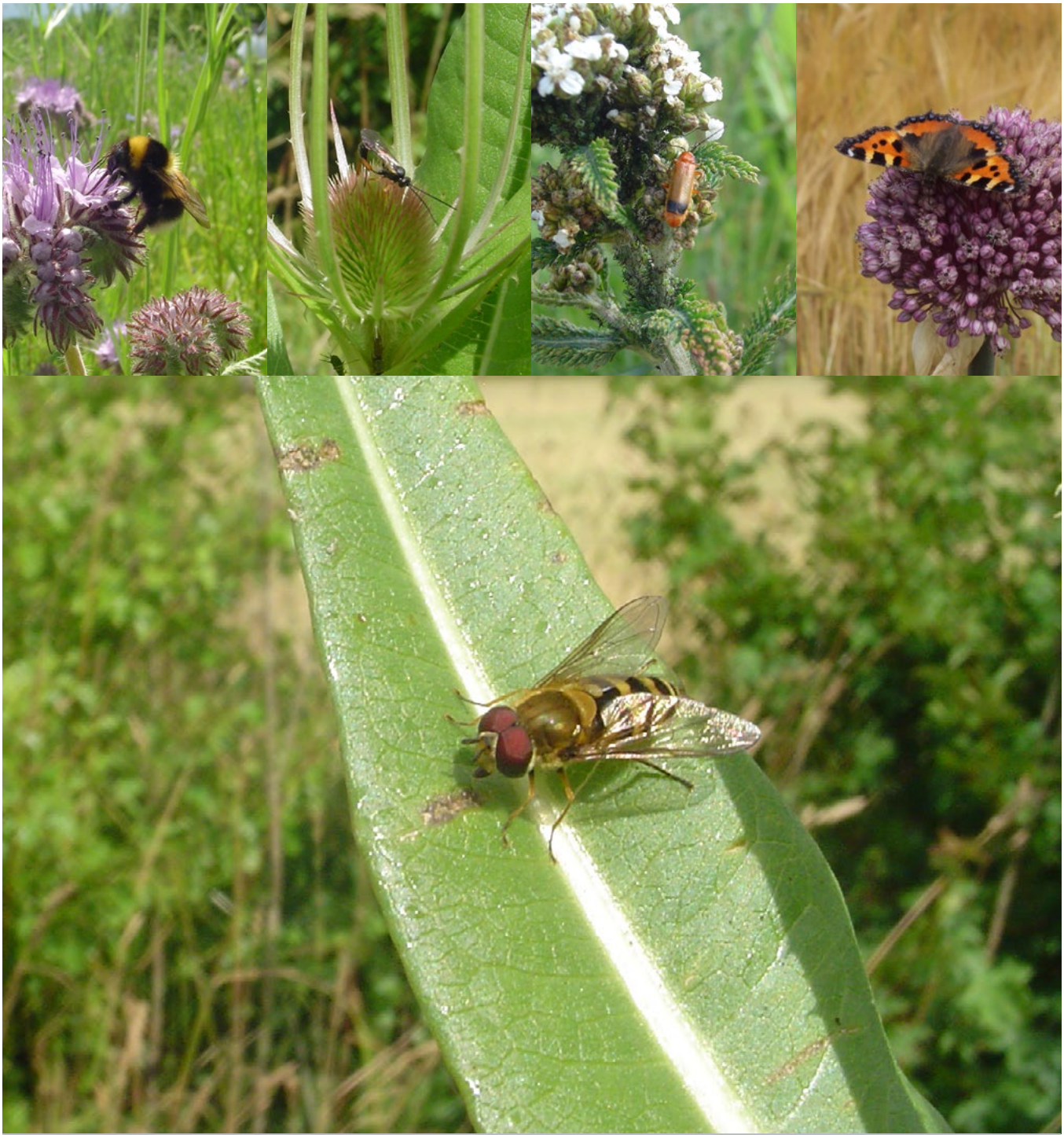
** NB: Other agri-environment scheme options also contain flowering plants, though they may be more prescriptive on which species can be included in seed mixes.*

Will any flowering seed mix do?

Though a range of flowering plant seeds may be included in all flowering seed mixes, selecting a mix at random from the many available options is not always the most cost-effective solution. There are several reasons for this:

1. 'Generalist' seed mixes do not necessarily contain plant species suited to agricultural settings, and therefore selecting such a mix may result in poor and disappointing establishment.
2. 'Generalist' seed mixes often contain seeds of flowering plant species that may be used by pests of certain crops. Small plot studies have shown that inclusion of such flowers can increase crop pest burdens.
3. Most nectar and pollen mixes have been designed specifically with bees and butterflies in mind. Consequently, poor provision is made for pest natural enemies, such as parasitoid wasps and hoverflies, which cannot necessarily utilise bee/butterfly-friendly flowers. Similarly, seed mixes designed specifically to promote biological control providers are not always beneficial for pollinators.

Careful selection of the seed mix used is therefore essential if multiple beneficial insect groups are to be encouraged with a single sowing, whilst also minimising the resources provided to pest insects. In short, not all seed mixes are created equal.



2. Examples of different insect groups that can be simultaneously promoted through flowering seed mixes with careful seed selection. From top left: Bumblebee feeding from *Phacelia*; Parasitoid wasp on teasel; Soldier beetle on yarrow; Tortoiseshell butterfly on *Allium*; Main: Hoverfly resting on a teasel leaf. *All pictures taken by David George.*

Margin management

Step 1: Site selection

It is generally accepted that flowering seed mixes perform and establish best when sown in nutrient-poor soil, where they have a competitive advantage over undesirable weed species and grasses. Where this is not possible, measures to reduce soil fertility prior to sowing may be used to limit weed issues. One recommended method is to sow a quick-growing, non-leguminous green manure crop, such as *Phacelia* or buckwheat, then mowing this and clearing the cuttings. Through this approach soil fertility should be reduced with each 'sow and mow' cycle. Where high nutrient seed beds cannot be avoided it is worth remembering that increased post-sowing management may be needed to ensure good establishment of flowering seed mixes.

Further work still needs to be done to allow minimum effective sizes of sown areas to be recommended. The Ecostac project demonstrated that benefits can be realised from flowering margins measuring a mere 65m in length and 2m wide. These dimensions will almost certainly be exceeded when mixes are sown at commercial scales, with increased value to beneficial insects expected as a result. In most instances, sizes will be dictated by existing field lengths and regulations governing minimum widths and areas, at least where margins are to be included as agri-environment scheme options. To aid establishment, north and east facing sites should ideally be avoided.

Step 2: Site clearance and weed control

In order to clear a site for sowing, it is recommended that the 'stale seedbed technique' is used where possible. Prepare the seedbed by initially clearing the selected area, and then allow a flush of weed seed germination. Resulting weeds can then be cleared to produce a cleaned 'stale' seedbed, which should now have a reduced weed seed burden.

Step 3: Seedbed cultivation

Soil should be cultivated to sufficient depth to alleviate compaction and bury any trash present. The seedbed should then be raked or harrowed and rolled to produce a fairly fine, firm surface. As a guide, the finished seedbed should be firm enough to walk on without leaving impressions.

Step 4: Seed sowing

Seed mixtures should be sown evenly onto the prepared soil surface by hand-broadcasting, seed fiddle, seed/fertiliser distributor, hydra-seeding, or any other suitable recommended method. Bulking the seed mix with an inert carrier, such as sand, can aid in achieving an even distribution. Seed may also be drilled, though as most wild-flower seeds are very fine and cannot germinate if buried, drills must be set as shallow as possible and to a maximum depth of 7mm. If seed has been hand-broadcast, beds may benefit from light raking post-sowing to better ensure even seed spread, though care is essential not to bury the seed.

Following sowing, beds should be rolled or tread, particularly in dry weather and with freshly-worked loose soil. This presses the seeds into contact with the soil, brings moisture to the surface, and maximizes germination rates as a result.

It is generally recommended that seeds are sown in either autumn (August-September) or spring (March-April). Timing is, however, weather-dependent and may be dictated by specified sowing dates for agri-environment scheme options (Table 2). The over-riding aim is to sow when warm and moist conditions predominate, while remembering that the seeds of some flowering species, such as those of yellow rattle, require a period of cold weather to germinate (and are therefore likely to perform better if autumn sown).

Step 5: Aftercare

Conditions specific to each site will determine sown flower establishment and grass/weed growth characteristics, and will therefore govern the level of aftercare required. All sown areas will require some level of management at some point, particularly in early years when using a perennial, non-rotational seed mix. Such management is essential to restrict grass/weed growth and maintain sward diversity.

In the absence of grazing, mowing is the primary means of managing grass species, as well as some weed species. Herbicide application may also be considered to manage injurious weeds, though if mixes are included in agri-environment schemes, and/or as EFAs, then regulatory guidelines should be consulted prior to product application.

'Blanket mowing' is not recommended as a management technique at times when flowers are likely to be in heavy use by beneficial insects. Certain agri-environment scheme options

3. Flowering seed mixes are typically sown to border crop edges as field margins. *Picture taken by David George.*

also require that a percentage of the plot is left unmown over winter to provide undisturbed habitat. Staggered mowing can be generally recommended, ensuring that floral resources for beneficial insects are always present, even where regular cutting is necessary. Staggered mowing has the additional advantage of introducing structural variation in terms of sward height, which has been shown to benefit both beneficial invertebrates and some farmland birds.

Regardless of the adopted mowing regime, it is recommended that the sward is cut to around 10cm. Cuttings should be removed post-mowing to keep soil fertility low, particularly where large quantities of clippings have been generated.

4. Aftercare is key to ensuring that a diverse stand develops (left), where otherwise grasses may come to dominate (right). *Pictures taken by David George.*

Table 2. Selected flower-based agri-environment scheme options (2015) with their respective establishment and management guidelines. Information obtained from gov.uk/countryside-stewardship-grants

Option	Establishment and management
Nectar flower mix (AB1) Mid & Higher	Establish between 15 March and 30 April, or 15 July to 30 August. Rotationally cut 50% of the plot area each year between 15 April and 31 May – don't cut the same area in successive years. Cut the whole area between 15 September and 30 March, removing or shredding cuttings. Don't graze between 15 March and 31 August.
Flower rich margins and plots (AB8) Mid & Higher	Establish between 15 March to 31 May or 15 July to 15 October. Cut plant growth (and remove if dense) if it is more than 15cm in height before 31 March, to achieve a plant height of between 5cm and 10cm tall. Cut (and remove if dense) or graze, 90% of the area between 15 August and 31 October to leave a plant height of between 10cm and 20cm. Leave 10% of the area uncut or ungrazed to provide overwintering habitat.
Legume and herb-rich swards (GS4) Mid & Higher (with other conditions met)	Manage the sward by cutting or grazing. Leave the sward to rest for at least five weeks between 1 May and 31 July, so that the majority of red clover flowers are open and available for pollinators.

Can flowering seed mixes fit within an integrated approach?

The compatibility of flowering seed mixes with IPM approaches is one of their most attractive features. Work undertaken on Ecostac and similar projects has indicated that, in addition to boosting pollination and pest control when employed as stand-alone options, flowering field margins may also be used in combination with other techniques and to serve a varied range of purposes. Several leading research institutions throughout the UK are currently investigating the broader benefits, and integrated use, of multifunctional flowering seed mixes.

Integrated approaches

When combined with other on-farm features, areas sown with flowering seed mixes may prove particularly useful in the provision of additional habitat for any beneficial insects that use them. For example, features including hedgerows and wooded areas are often important over-wintering sites for predators and parasitoids of pests, and may be already present in the landscape. Though it is not generally recommended that flowering seed mixes are sown adjacent to established hedges, having both winter and summer habitats on-farm in relative proximity to one another should be mutually beneficial for any insect that requires both types of habitat.

5. Flowering field margins may be successfully sown near to small hedges, though sowing adjacent to larger hedges can result in poor establishment. *Picture taken by David George.*

Flowering field margins may also prove useful as buffers. They can protect sensitive landscape features such as watercourses, and may also aid in minimising leaching and soil erosion from field edges.

Beyond field margins

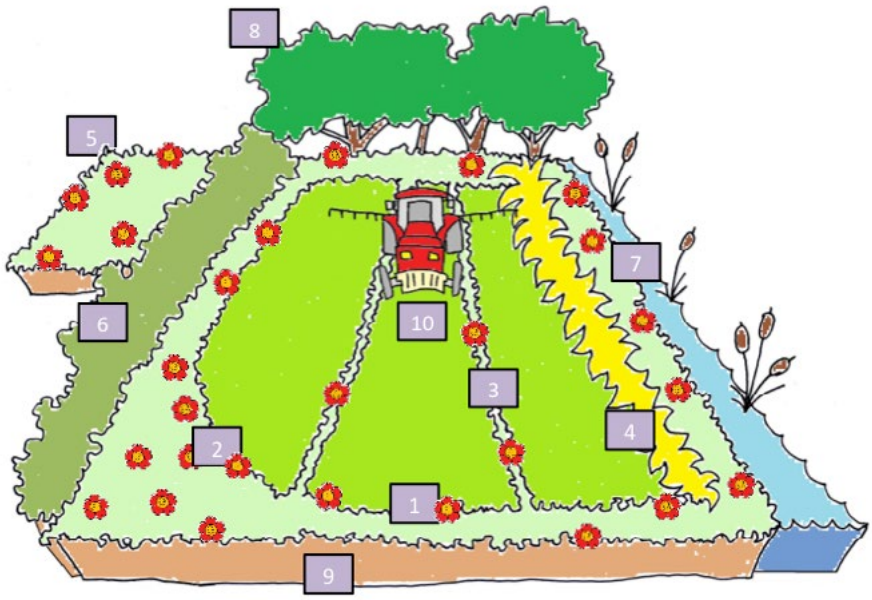
Though often sown as crop borders, flowering seed mix use isn't limited to field margins. Mixes may be sown onto fallow sites as cover, thus boosting on-farm beneficial insects while potentially improving soils. Awkward corners contributing little to farm productivity are also ideal candidates for sowing with floral seed mixes.

Recent studies have trialled flowering seed mixes sown as cover in wheelings to help in alleviating compaction whilst simultaneously providing floral corridors for pollinators and natural enemies to access the crop interior. Mixes were incompatible with weeding programmes, though in-crop deployment may become more achievable with advances in precision farming techniques. The Ecostac project recommended a selection of further uses for margin seed mixes, though seed mix compositions and rates may need to be optimised to suit different applications.

Use with agrochemicals

As long as products are selected and deployed in a considered manner, many should be compatible with flowering seed mixes, even when sown adjacent to crop fields. When used with a flowering field margin approach, for example, beneficial insects should be afforded some protection from spraying when residing in the margin, assuming that measures are taken to avoid drift. 'Reduced risk' products (see AHDB Horticulture Factsheet 18/14: Getting the best from biopesticides) are likely to be most compatible, often displaying short residual activities that would minimise impact on beneficial insects entering the crop after treatment.

Floral mixes and multiple uses



No.	Floral mixes can be used…
1	As a stand-alone field margin.
2	As an option for awkward corners.
3	As cover for wheelings and to alleviate compacted soils.
4	In conjunction with trap crops.
5	As soil improvers for lay sites.
6	In conjunction with hedges.
7	As buffers for water courses.
8	In conjunction with wooded edges.
9	To minimise erosion and leaching at field edges.
10	In conjunction with considered chemical use.

6. Multiple uses for flowering seed mixes suggested by the Ecostac project. *Infographic prepared by David George.*

Accessible related reading

Articles and guides

van Rijn *et al*, 2008. Functional Agro-Biodiversity in Dutch arable farming: results from a three year pilot. IOBC-wprs Bulletin, 34: pages 125-128. Summary of Dutch biocontrol margins work: dare.uva.nl/document/2/61879

van Uden (Ed), 2012. Functional agrobiodiversity: Nature serving Europe's farmers. European Learning Network on Functional AgroBiodiversity (ELN-FAB), 60p. See: eln-fab.eu/uploads/ELN_FAB_publication_small.pdf

Boys, E (Ed), 2011. Enhancing arable biodiversity through the management of uncropped land – a guide. AHDB Horticulture. AHDB Cereals & Oilseeds guide based on the Farm4Bio Project. See cereals.ahdb.org.uk/media/178501/g51_enhancing_arable_biodiversity_through_the_management_of_uncropped_land.pdf

O'Neill T and Gwynn R, 2014. AHDB Horticulture Factsheet 18/14: Getting the best from biopesticides. AHDB Horticulture. See horticulture.ahdb.org.uk/publication/1814-getting-best-biopesticides

George and Banfield-Zanin, 2015. More than a marginal impact. AHDB Grower, Feb 2015: pages 16-18.

Useful websites

ecostac.co.uk – Ecostac project

stockbridgetechnology.co.uk/Automated_Margins – Automated Margins Project

eln-fab.eu – European Learning Network on Functional AgroBiodiversity

saffie.info – SAFFIE project

operationpollinator.com – Operation Pollinator

horticulture.ahdb.org.uk/sites/default/files/research_papers/FV%20231%20Final%20Report%202004.pdf – 3D Farming Project (Final Report)

gov.uk/countryside-stewardship-grants/ – recent information on agri-environment scheme options

Acknowledgements

We kindly thank Dr Paul van Rijn (University of Amsterdam) for allowing us to reproduce the cover image. The Automated Margin Design project (AHDB Horticulture FV 334a) was funded by AHDB Horticulture and conducted by Stockbridge Technology Centre Research Foundation (UK). The HortLINK Ecostac project HL0192 (Perennial field margins with combined agronomical and ecological benefits for vegetable rotation schemes) was conducted jointly at Lancaster University (UK), Stockbridge Technology Centre Research Foundation (UK) and the Food and Environment Research Agency (UK). Financial support was provided by the UK Government (Department for Environment, Food and Rural Affairs) and industry participants (AHDB Horticulture, AHDB Cereals & Oilseeds, Processors and Growers Research Organisation, Westhorpe Flowers and Plants Ltd, Produce World Ltd, National Farmers Union, Mark H Poskitt Ltd, J.F.D. Hargreaves Ltd, Waitrose Ltd, Sainsbury's Supermarkets Ltd, Linking Environment And Farming, Donald McIntyre (Emorsgate Seeds), Growing Wild Ltd, Bayer CropScience Ltd, Syngenta Ltd, Dow AgroSciences Ltd, Koppert Biological Systems BV, BCP Certis Ltd, Unilever UK Central Resources Ltd and Birds Eye Ltd).

Want to know more?

If you want more information about AHDB Horticulture, or are interested in joining our associate scheme, you can contact us in the following ways...

horticulture.ahdb.org.uk

AHDB Horticulture, Stoneleigh Park, Kenilworth, Warwickshire, CV8 2TL

T: 024 7669 2051 E: hort.info@ahdb.org.uk

@AHDB_Hort

AHDB HORTICULTURE

AHDB Horticulture is a division of the Agriculture and Horticulture Development Board (AHDB).

£8.75 where sold

HT900107 15