

BENEFICIAL INSECTS

Boosting Habitats to Encourage
Natural Predators & Reduce Pests
in UK Crops

COTSWOLD
Grass Seeds
— DIRECT —

BENEFICIAL INSECTS FOR AGRICULTURE & HORTICULTURE



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Richard trained as an applied biologist and has spent over 25 years working as an Integrated Pest Management (IPM) specialist and entomologist in horticulture and agriculture. This included working with ADAS as an entomologist and crop advisor. Richard is the Managing Director of FreshTec, an Agrotec consultancy business based near Cambridge in the UK. Richard works with international companies that support farmers and growers including Koppert Biological Systems (UK) Ltd where he works with horticultural businesses, helping growers manage and develop bespoke IPM systems. Richard also works with a range of businesses involved in the food chain including fresh produce businesses that supply food retailers.



SAM LANE

Sam Lane is the Technical Manager at Cotswold Seeds.

Sam has been involved in farming and the rural environment all his life. In 2009 he graduated with an agricultural and environmental degree from Harper Adams University in Shropshire, after which he worked on a large arable estate in Oxfordshire, carrying out many practical duties day to day.

He joined Cotswold Seeds eight years ago, providing farmers with technical advice on complex grass seed mixtures, and visiting farms all over the UK. Sam regularly represents Cotswold Seeds at agricultural shows, technical events and seminars. He is often invited to give talks and presentations to farming groups, on everything from forage seed mixtures, environmental stewardship and soil health.

Complex seed mixtures and the benefits they bring to animal health, soil fertility and farm profitability are at the heart of much of Sam's work at Cotswold Seeds and he's co-authored many of Cotswold Seeds' technical publications, including 'The Herbal Ley Farming System', 'Mob Grazing Guide' and 'Sort out Your Soil.'



Contents

- 5 How Do We Control Pests In UK Cropping Systems?
- 6 How Can Beneficial Insects Help Us?
- 7 What Are Beneficial Insects?
- 8 Key Horticultural & Arable UK Crops and Associated Pests
- 12 Top 8 Pest Controlling Beneficial Insects
- 14 Why Sow Flowering Mixes?
- 16 Common Plant Species Used In Flowering Insectary Strips
- 18 A Place To Overwinter
- 19 Integrating Target Plants Into Cropping Systems
 - Annual Flower Mixes
 - Perennial Flower Mixes
 - Beetle Banks
 - Permanent Grass and Wildflower Habitats
- 21 Sowing & Growing Guidance
- 22 Case Study – Deepdale Farms
- 22 Conclusion
- 23 Glossary

Fact

There is estimated to be 10 quintillion insects in the world



How Do We Control Pests in UK Cropping Systems?

Non-crop flowering resources in agriculture and horticulture have become scarce in UK based farming landscapes. As a consequence, the presence of beneficial insects has declined resulting in less 'natural' pest control and pollination efficacy.

By sowing non-crop flowering areas you can improve the farming landscape for beneficial insects and enhance biodiversity. This can have a range of benefits including:

- Improved biological (natural) pest control.
- Greater pollination of crops, increasing yield.
- Increased buffering at field margins, reducing soil erosion and runoff.
- Boosting food sources for farmland wildlife.

For over 30 years seed mixes have historically been developed and used to provide habitats for farmland birds. In the 1990s this began to change. Flowering seed mixes rich in pollen and nectar were introduced to address the decline in farmland pollinators. The introduction of Countryside Stewardship grants and other environmental initiatives such as LEAF has encouraged more farmers to plant pollinator friendly mixes.

During this period, practises on farms to control insect pests has majored around the use of insecticides, as they were relatively cheap and resulted in obvious reductions in insect populations. In recent years though they have become victims of their own success. The intensive use of insecticides have driven the development of insecticide resistance in key pests such as aphids. This is also impacting on non-target farmland species including natural insect predators and key pollinators. This in turn has led to increased restrictions on their use. A more appropriate strategy is to use IPM (Integrated Pest Management) where a combination of non-chemical and chemical methods are used to control the target pest. Less reliance on insecticides is also a fundamental part of the SUD (Sustainable Use Directive) and will help to slow down the insecticide resistance developing in some insect populations.



Non-crop flowering resources in agriculture and horticulture have become scarce in UK based farming landscapes.

Fact

When food is scarce, Ladybirds have been known to lay infertile eggs alongside the fertile ones as a food source for its young once they've hatched.

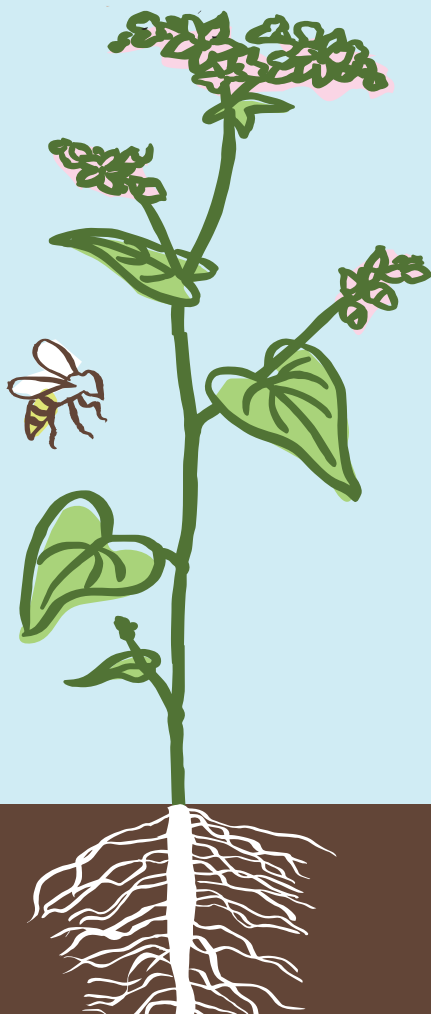
How Can Beneficial Insects Help Us?

Natural enemies, in particular those that target aphids and other soft bodied pests are able to reduce populations and should be a key component of any IPM strategy. Reducing pest numbers in crops can help prevent them from reaching economically damaging levels. However natural predators need essential resources such as food and over-wintering sites which are not normally available in short term cash crops.

Several species of parasitic wasps and hoverflies require nectar and pollen as food to provide energy and protein for egg development. These resources can come from the inclusion of floral mixes onto farmland. This strategy is known as Conservation Biological Control (CBC) which is defined as 'the modification of the environment or existing practises to protect and enhance specific natural predators to reduce the effects of pests'.

Fact

One of the collective nouns for Ladybirds is 'a loveliness'.



What Are Beneficial Insects?

Beneficial insects can be divided into two types: **Generalist** or **Specialists**. Generalist insects will roam and eat what they can catch whereas specialists will target specific prey species.



Whether Generalist or Specialist their impact will be greatly reduced if additional resources are not met. These include additional food resources such as pollen nectar as well as a suitable habitat environment.

Another category beneficial insects can be put into is whether they are classed as Parasitoids or Parasites:

- **Parasitoids** will lay their eggs inside a host bringing eventual death once the larvae have eaten their way out.
- **Parasites** live on or in a host, for example, Mites, Ticks and Lice. The parasite will derive the host of nutrients, but doesn't necessarily result in the hosts death.

Fact

The weight of all insects in the world would be around 70x more than all humans.



Key UK Crops & Associated Insects

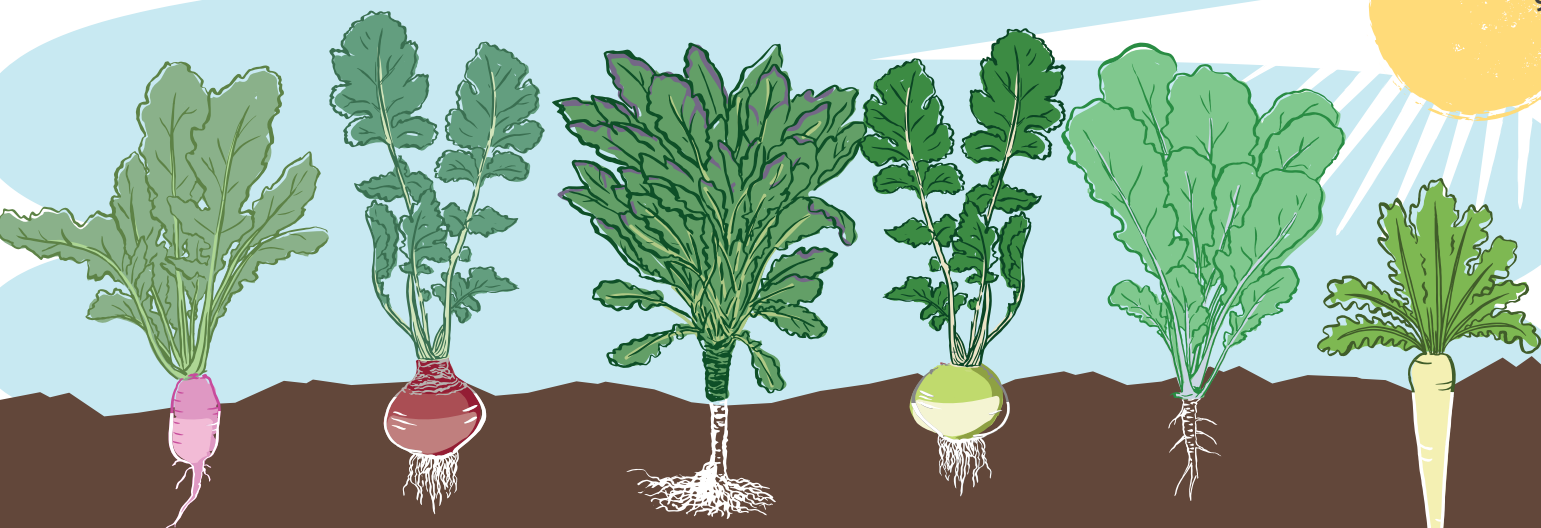
FIELD VEGETABLES

Umbellifers – Carrots, Parsnips, Celery

| Insect Pest | Associated Beneficial Insects |
|--|--|
| Willow Carrot Aphid <i>Cavariella aegopodii</i> | Parasitic Wasps Lacewings Ladybirds Hoverflies Gall Midges |
| Spider Mite <i>Tetranychus urticae</i> | Lacewings Flower & Pirate bugs |

Brassicas – Cauliflower, Cabbage, Brussel Sprouts

| Insect Pest | Associated Beneficial Insects |
|---|---|
| Aphids: Cabbage Aphid <i>Brevicoryne brassicae</i> Peach Potato Aphid <i>Myzus persicae</i> Potato Aphid <i>Macrosiphum euphorbiae</i> | Parasitic Wasps Lacewings Ladybirds Hoverflies Rove Beetles |
| Caterpillars: Diamondback Moth <i>Plutella xylostella</i> Silver Y Moth <i>Autographa gamma</i> Cabbage Moth <i>Mamestra brassicae</i> White Butterfly (large and small) <i>Pieris brassicae</i> and <i>Pieris rapae</i> | Parasitic Wasps Lacewings Assassin bugs Rove Beetles |
| Onion Thrips <i>Thrips tabaci</i> | Pirate bugs Rove Beetles Lacewings |



Alliums – Bulb Onions, Salad Onions, Leeks

Insect Pest

Onion Thrips
Thrips tabaci

Leek Moth
Acrolepiopsis asscetella

Associated Beneficial Insects

Pirate bugs
Rove Beetles
Lacewings

Parasitic Wasps
Lacewings
Assassin bugs
Rove Beetles

Legumes – Peas & Beans

Insect Pest

Thrips:
Field Thrips
Thrips angusticeps
Pea Thrips
Kakothrips pisivorus

Pea Aphid
Acyrtosiphon pisum

Caterpillars:
Pea Moth
Cydia nigricana
Silver Y Moth
Autographa gamma
Flax Tortrix Moth
Cnephasia asseclana

Pea Midge
Contarinia pisi

Associated Beneficial Insects

Pirate bugs
Rove Beetles
Lacewings

Parasitic Wasps
Lacewings
Ladybirds
Hoverflies
Rove Beetles

Parasitic Wasps
Lacewings
Assassin bugs
Rove Beetles

Lacewings



Cucurbits – Squash, Pumpkin

Insect Pest

Aphids:

Black Bean Aphid
Aphis fabae
 Melon-Cotton Aphid
Aphis gossypii
 Peach Potato Aphid
Myzus persicae

Spider Mite
Tetranychus urticae

Thrips:

Onion Thrips
Thrips tabaci
 Western Flower Thrips
Frankliniella occidentalis

Associated Beneficial Insects

Parasitic Wasps
 Lacewings
 Ladybirds
 Hoverflies
 Rove Beetles

Lacewings
 Flower & Pirate bugs

Pirate bugs
 Rove Beetles
 Lacewings

Fact

Some species of Hoverfly are known to mimic bees by waving their legs in front of their faces, pretending to have antennae. This means they can enter the Bee's nests to lay their eggs.





Potatoes

| Insect Pest | Associated Beneficial Insects |
|--|---|
| Aphids: Peach Potato Aphid <i>Myzus persicae</i> Potato Aphid <i>Macrosiphum euphorbiae</i> | Parasitic Wasps Lacewings Ladybirds Hoverflies Rove Beetles |
| Caterpillars: Silver Y Moth <i>Autographa gamma</i> | Parasitic Wasps Lacewings Assassin bugs Rove Beetles |

Arable Crops – Cereals

| Insect Pest | Associated Beneficial Insects |
|--|---|
| Grain Aphid <i>Sitobion avenae</i> Rose Grain Aphid <i>Metopolophium dirhodum</i> | Parasitic Wasps Lacewings Ladybirds Hoverflies Rove Beetles |
| Frit Fly <i>Oscinella frit</i> | Rove Beetles |
| Orange Wheat Blossom Midge <i>Sitodiplosis mosellana</i> | Parasitic Wasps Lacewings |
| Wheat Bulb Fly <i>Delia coarctata</i> | Rove Beetles |
| Yellow Cereal Fly <i>Opomyza florum</i> | Ladybirds Soldier Beetles |

Top 8 Pest Controlling Beneficial Insects



1. Ladybirds

Ladybirds can be identified by their bright red / orange outer shell and the number of spots can vary between species.

They prey almost exclusively on Aphids but also on scale insects and Spider Mites.

Ladybird eggs are recognised by their elongated, oval shape and are laid end up in batches, with the colour of the eggs varying from light yellow to dark orange.

They can lay hundreds of eggs in the colonies of Aphids, so that the Ladybird larvae can begin feeding as soon as they have hatched.

From being a brand new larvae to fully grown adult, just one Ladybird can eat up to 5000 Aphids in its lifetime.

Ladybirds will not damage crops. Instead, they carry out the vital role of controlling species of pest insects that will damage these crops.



2. Hoverflies

Often confused with Wasps because of their similar yellow and black colouring. The markings help protect the hoverfly as the bright colours help to confuse predators into thinking that they will harm them if they are preyed upon.

They are highly mobile predators, which can fly in bursts of up to 40kmph.

Hoverflies lay their eggs on plant foliage near to their prey. Once the larvae have hatched, they begin feeding straight away.

They are extremely useful predators, the larvae can consume over 50 Aphids a day and are capable of preventing Aphid outbreaks.

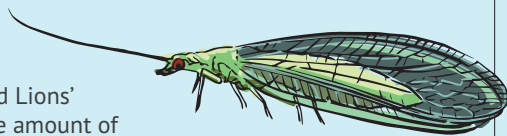
Adults feed on pollen and nectar. Some hoverflies can struggle to feed from specific plants such as Clover, Lucerne and Sainfoin because of their mouth shape or the accessibility of certain flower shapes. Care should be taken to provide them with the right food source.

3. Lacewings

Adults are easily recognised by their transparent lace-like wings. They consume nectar, yeast, pollen, and honeydew. The eggs are laid on foliage near the Lacewing's prey, making it easier for the larvae to get to once they've hatched.

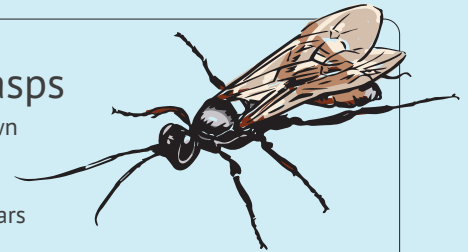
Lacewing larvae prey on soft bodied insects, especially Aphids. The larvae have specialised mouthparts with large jaws that interlock to form pincers, leading to a fairly gruesome death for its prey. Once impaled on these pincers, a prey's body contents are sucked out through hollow food channels running between the jaws.

Lacewing larvae have been given the nickname 'Aphid Lions' due to the huge amount of Aphids they can consume per day!



4. Parasitic wasps

Parasitic Wasps are known to parasitise over 200 species of pests which include Aphids, Caterpillars and Beetle larvae.



This parasitoid has developed venoms to immobilise their host. This gives them the advantage of keeping prey fresh and immobile for their young to eat once hatched. They also have an ovipositor that can place eggs very precisely even in extremely small spaces.

Most female Parasitic Wasps lay eggs inside or on host insects and are even known to lay their eggs inside it's prey's eggs. This stops the pest insects from further reproducing, limiting the amount colonies will grow. Some species will chemically mark a host so others know eggs have already been laid, reducing the chances of their offspring having to fight for food.

The eggs hatch and consume the host insect, beginning with non-essential tissue first, then proceeding to vital organs. They eat their way out, eventually killing the host insect.

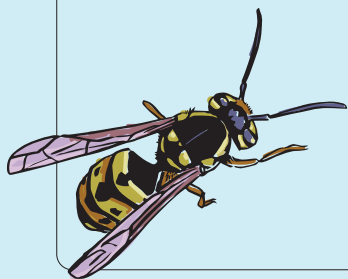
The size a Parasitic Wasp grows to will depend on the size of the host insect that it's egg was laid on/in, varying from 2mm-30mm in length.

5. Wasps

There are over 9,000 species of Wasp in the UK, with the Yellow Jacket being by far the most common.

Like Bees, Wasps live in colonies. They aren't as good at pollinating as Bees are although, along with Hornets, they are some of the best species for natural pest control.

They feed on an array of pests including; Caterpillars, Aphids, and Leaf Beetles.



An adult diet consists of sugars and carbohydrates whereas the larvae are looking for high protein food such as insects. The workers will collect the insects and chew them up before feeding them to their young.

6. Ground Beetles

Ground beetles are very effective predators. An area with high numbers of ground beetles is a well known sign of healthy soil.

Some beetles have the ability to climb plants meaning they can consume pests like Aphids that may already be attacking a crop higher up.

Ground beetles consume many pests such as Aphids, Caterpillars and Slugs. Some species can even eat up to four times their own body weight in prey each night.

Adding a combination of grass and flower margins alongside crops will encourage Ground beetles. This is not only good due to their effective pest insect control but they also benefit the soil by breaking down organic matter, aerating and just generally keeping soil healthy. As many of these beetles only travel less than 250m, having shelter like this with a food source in the same place is extremely beneficial for them and the area they live in.



7. Soldier beetles

There are over 40 species of Soldier beetle in the UK.

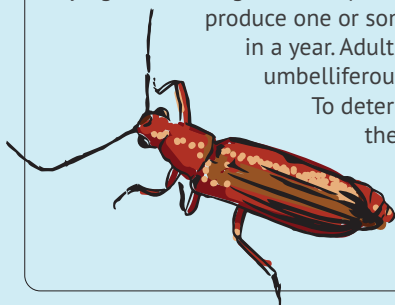
Soldier beetles are very useful generalist predators. Adults can feed on nectar, pollen and honeydew but are also carnivorous, feeding on soft bodied insects like Aphids and Caterpillars.

Larvae will prey on ground dwelling creatures such as Slugs and Snails. As they are able to climb, they will wait in the long grasses for prey to appear below them.

Adults are generally able to fly, making them capable of flying from a margin to a crop with ease. They usually

produce one or sometimes two generations in a year. Adults are normally found on umbelliferous flowers at mating time.

To deter predators from consuming them, the Soldier beetle will release a foul smelling chemical to tell them not to eat them – they don't taste nice!



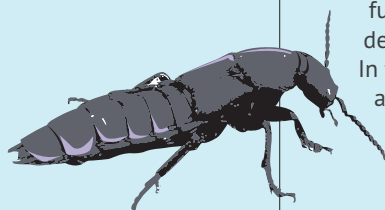
8. Rove Beetles

There is a wide variety of Rove Beetles in the UK, they range both in size and colour, some have more distinctive red features, most are black or brown with elongated bodies, which is why they can be mistaken for earwigs. There are approximately 1000 species of Rove Beetle in the UK alone, 40-50 of these can be considered highly beneficial in pest control on agricultural crops. An adult Rove Beetle will live for between 40-72 days, there are usually two generations born in a year.

Their size can vary from 2-30mm, some species are also winged. They will breed from February and will continue into the winter. The eggs of a Rove Beetle are between 0.3-0.5mm in size, they are produced between May-June; the female will lay their eggs in the soil. Once the eggs hatch the larvae need to find a host, they will look for pupa of usually a maggot, they then bury and pupate in the pupa of the host. After 3-4 weeks they will emerge as an adult. The larvae are off-white or beige in colour with dark heads, they like adults will feed on pest species such as aphid larvae, mites, moths and springtails.

Rove Beetles fall into two categories 'generalist' and 'specialists'. One species in particular, *Atheta coriaria* can be bred and released into cropping areas to target specific pests such as sciarid and shore flies. Some of the larger Rove Beetle species have been known to prey on caterpillars, slugs and snails.

All species of Rove Beetles are susceptible to insecticides/ fungicides, this goes some way to explaining their decline on farmlands, another is destruction of habitat. In terms of their habitat they can be found in woodland and tussocky grass areas around fields. They over-winter under rocks, bark or in grass tussocks, in the warmer months you will find Rove Beetles in crop areas searching for their prey.





Why Sow Flowering Seed Mixes?



Although grass only mixes can certainly be useful for some insect groups, it is well documented that many beneficial insects and pollinators need access to flowering plants. A reliable pollen and nectar source can improve the lifespan of insects, enhance insect activity, boost reproduction levels and provide shelter for overwintering insect populations. Therefore, optimum returns from beneficial insects can be maximised using flowering rather than just grassy seed mixes. A further benefit to planting these seed mixtures is that some flowering mixes satisfy current agri-environment schemes, allowing growers to be paid to establish and maintain them.

Maximising the range of flowering plants in a mixture

Diverse flower mixes support diverse populations of beneficial insects. This diversity helps to provide species with an entire diet whereas planting single species of plants will reduce the amount of insects attracted. For example, hoverflies cannot get the necessary nectar from Phacelia which they convert into carbohydrates, they can only access the pollen so they would need to look for another food source.

Similarly a wider range of flowering species in a mix widens the flowering window helping successive flowering blooms to provide nectar and pollen throughout the growing season to sustain beneficial insects and pollinator populations.

Size & location tips

- Fields with an abundance of non-crop habitats around them tend to support more beneficial insects.
- Smaller fields mixed with natural areas allow beneficial insects to move deeper into crop fields.
- Habitats should be located as close to the crop as possible – therefore care should be taken if pesticides are used. Some insects can travel long distances, however some (i.e. Ground Beetles) can only travel a few metres. Insectary strips can be useful to allow insects with a reliable habitat to further colonise throughout large fields.

Shelter

Beneficial insects require shelter to survive the winter or adverse weather conditions, it also provides beneficial insects areas to lay eggs or move from larval to adult life stages. This structural diversity on a farm will increase the number and type of beneficial insects.

The importance of hedgerows

While it's not the focus of this document, hedgerows are also very important for insects, creating corridors and linking up habitats, as well as providing valuable, permanent cover for over wintering. Thought should be given to species selection when planting new hedgerows and just as importantly the management of existing hedges for insects should be considered, this is an area that needs further research.





How To Select The Right Flowering Seed Mix?

To encourage multiple beneficial insect groups, careful selection of seed mixes must be undertaken whilst ensuring that resources for pest insects are minimised.

Legume-based flower mixes such as clover and trefoil can be easy to establish. They provide a reliable source of flowers for pollinators and other insects, however these varieties are usually based around agricultural strains developed through plant breeding. This may mean that the aim of the plant breeding was yield or biomass resulting in changes occurring in the plant physiology making it more difficult for some species to extract pollen and nectar.

Agricultural strains also tend to have a shorter lifespan, but can be lower cost and readily available.

Wildflower mixes containing a wide range of species have the advantage of better persistence and a wider flowering window throughout the year.

There are both advantages and disadvantages to planting perennials and annuals:

- Annuals bloom in the first year.
- Annuals are easy to establish and fast to grow, but only last one year.
- Perennials take longer to establish (often up to 12 months).
- Some species may not produce flowers for two or three years – the tradeoff is the longevity of this type of strip compared to strips that contain annual species.
- Grasses can be incorporated into perennial mixes to provide insect habitat and overwintering sites.
- Slower growing perennials may require weeding in year one.

Flowering seed mix selection

Agricultural strains or true wildflowers?

Many seed mixes are designed to encourage pollinators and may not encourage natural enemies

Generalist seed mixtures may increase pest problems or be unsuitable for agricultural landscapes

Common Plant Species Used In Flowering Insectary Strips

For example, flowers with deep corollas will support Bees with long tongues. Shallow and open flower species are able to support short-tongued Bumble Bees and Hoverflies with shorter tongues.



Common Plant Species Used

ANNUALS

1 Cornflower

A pretty bright blue flower, once considered a weed of arable fields. The development of intensive agricultural practises nearly wiped out the Cornflower in the wild. This delicate, blue flower is now most likely to occur as a garden escapee, as part of intentional wildflower seeding, or as the result of the disturbance of soil containing old seed banks. Its strongholds remain on roadside verges, scrub, waste ground and farmland. It flowers from June to August, often alongside other 'arable weeds' (also called 'cornfield flowers') such as Corn Chamomile and Corncockle.

Attracts – Lacewing, Hoverflies & Ladybirds

2 Buckwheat

A short term, aggressive weed suppressor. With its quick growth, this plant can flower from seed in 8 – 10 weeks. It has a short lifespan.

Attracts – Lacewings, Hoverflies, Parasitic Wasps, Pirate & Flower bugs

3 Phacelia

Phacelia is a rapidly growing, high biomass plant. Its eye-catching purple flowers are particularly good at attracting Bees and other beneficial insects.

Attracts – Lacewings, Pirate & Flower bugs

PERENNIALS

4 Fennel

An easy to establish short term perennial plant, feathery in appearance with a notable 'aniseed' smell and yellow flowers. This member of the carrot family was traditionally grown for its flavouring and medicinal properties. It is attractive to pollinators and other beneficial insects because of its open umbelliferous flower head.

Attracts – Hoverflies, Ladybirds, Parasitic Wasps & Soldier Beetles

5 Yarrow

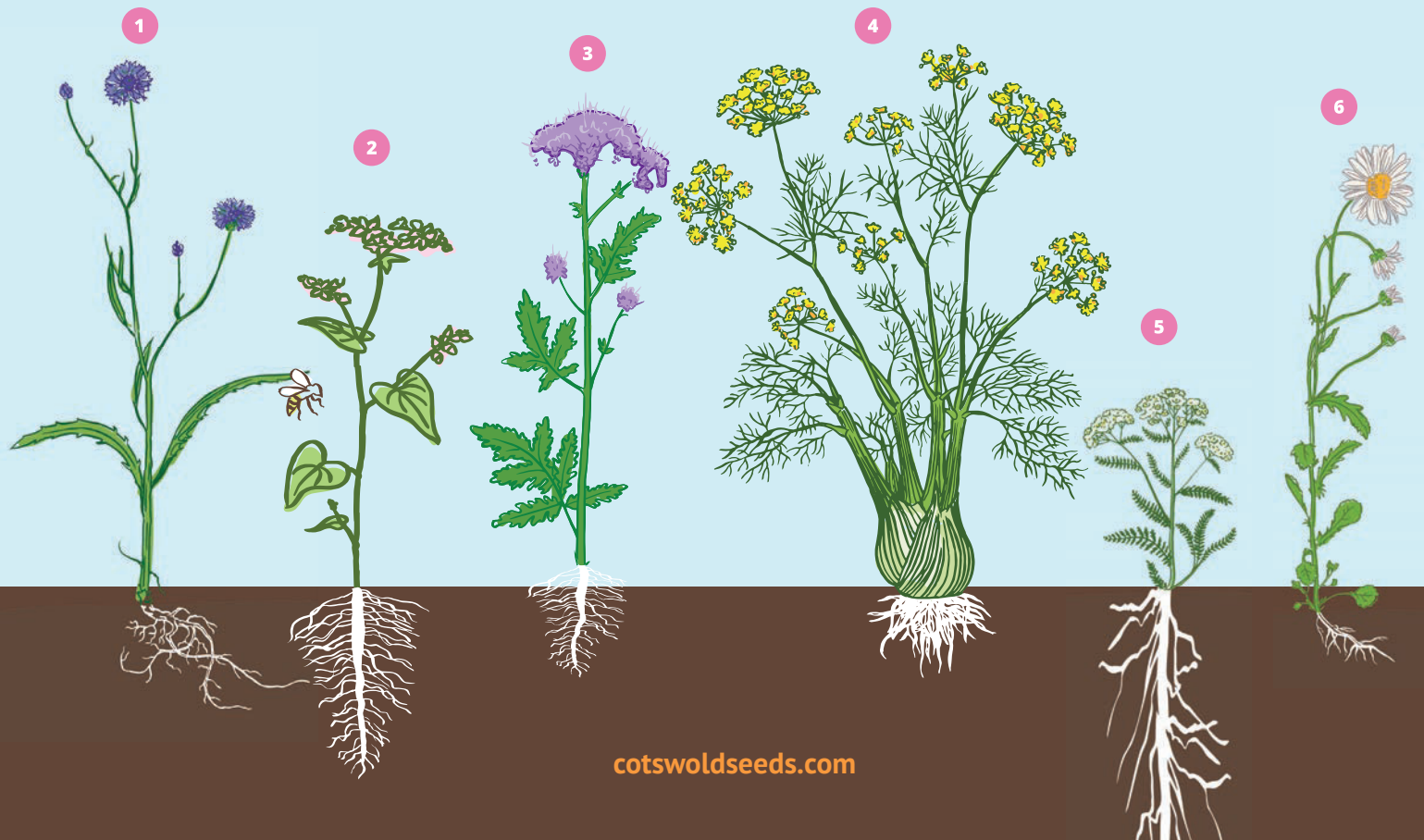
Yarrow grows from a particularly small seed, therefore just a pinch is all that's needed in seed mixtures. It has an open white to pink flower head and can flower late into autumn.

Attracts – Hoverflies, Ladybirds & Parasitic Wasps

6 Oxeye Daisy

A robust, reliable plant which grows on most soils. Found in meadows, pastures and banks. It has an eye-catching orange centre and white petals.

Attracts – Pirate & Flower bugs



In Flowering Insectary Strips



BIENNIAL

7 Birdsfoot Trefoil

Birdsfoot Trefoil has yellow and red flowers giving it's nickname 'Eggs & Bacon'. Often flowering all summer long. Shorter agricultural and true wildflower types are available.

Attracts – Parasitic Wasps

8 Red Clover

An attractive and easy to grow legume, the inflorescence can vary in colour from red to pink and very occasionally white. Red clover last for 2-3 years. Later flowering varieties are available.

Attracts – Pirate & Flower bugs

9 White Clover

White clover is one of the most popular legumes in the UK. White clover varieties can be categorised into small, medium and large leaf sizes. The larger leaf varieties such as Alice and Barblanca are larger more upright plants. Small leaved White clovers are sometimes known as 'Wild' and will arguably be friendlier to beneficial insects.

Attracts – Lacewings, Parasitic Wasps

10 Vipers Bugloss

A hairy plant with dense spikes of bright blue, funnel-shaped flowers. It is found on chalk grassland, sand dunes, cliffs and disturbed ground, and is in bloom from May to September. It provides food for a range of insects, including Buff-tailed and Red-tailed Bumblebees, Large Skipper and Painted Lady Butterflies, Honeybees and Red Mason Bees.

Attracts – Lacewings, Solitary Bees & Pirate bugs

11 Teasel

A tall plant found in field margins, particularly in the south of Britain. The teasel is probably best-known for its brown, prickly stems and conical seed heads, which persist long after the plants themselves have died back for the winter. Between July and August, when teasels are in flower, the spiky flower heads are mostly green with rings of purple flowers.

Attracts – Lacewings & Ladybirds



A Place To Overwinter

Beetle Banks & Buffer Strips

Beetle banks are typically a permanent grass strip that runs through an arable field. They are usually 2 metres wide, and slightly raised, the strips will either connect with the field margins, or be just short of the margins to allow machinery to pass easily.

They act as corridors to help spread beneficial insects throughout a field, especially those species that do not like to travel far to find food. Ground Beetles for example will only travel 250 metres or less to find food therefore using a beetle bank corridor means they are more evenly spread across the field and won't only be contained to the field margins.

There are recommendations for how many beetle banks should be situated in a field depending on the field size. For example, a 16 hectare field, two beetle banks are recommended. For areas 30 hectares or over, 4 banks are recommended. Having multiple banks will mean a wider spread of beneficial insects. It is also recommended if applying pesticides to leave a 6 metre gap in order to protect the banks from spray drift.

A combination of beetle banks across and buffer strips in/around arable fields will mean that beneficial insects can roam more easily.

For the horticultural sector there has been more interest in 'insectary strips' which are similar to beetle banks however they tend to be temporary lasting just a season. This makes it easier for growers to fit it in with their crop rotations.

Insectary strips are low-cost mixtures due to their temporary nature and contain rapidly blooming flower species. As the strips are destroyed at the end of the season they won't provide an over winter shelter. A good example of this type of temporary insectary strip is the 'Annual Insect mixture' (page 19).

Recent research has highlighted that the positive effects of many beneficial insects can drop off after 50 metres or so, this means that any infield strips should ideally be no more than 100 metres apart, to ensure the good work done by the insects is carried out evenly across the field.

Studies in the UK and research carried out in Europe has shown results which have been mainly positive showing a distinct reduction in pest damage on crops, where insect mixes are used. Many accept that these strips won't totally eradicate the use of pesticides, but that the amounts used could be greatly reduced. Using a combination of flowering strips, breeding plants with a better resistance to diseases and using technology to pinpoint potential pest attacks will mean that farmers have a lower dependence on pesticides.



Integrating Target Plants Into Cropping Systems

Annual Flowering Mixtures

A short term mixture that will provide an array of flowering species to attract beneficial insects and pollinators. It is recommended to sow in mid spring to provide a flowering cover in the year of sowing. This mixture can be used in arable or horticulture situations, across fields or in poly tunnels, when a temporary or short term resource is required.

Annual Insect Mix (MIXANBI)

| | |
|------------------------------|------|
| ■ Corn Marigold (wildflower) | 0.05 |
| ■ Corn Cockle (wildflower) | 0.10 |
| ■ Cornflower (wildflower) | 0.10 |
| ■ Certified phacelia | 0.20 |
| ■ Fenugreek | 0.40 |
| ■ Coriander | 0.40 |
| ■ Commercial balansa clover | 0.75 |
| ■ Certified crimson clover | 1.00 |
| ■ Certified berseem clover | 1.00 |
| ■ Certified persian clover | 1.00 |
| ■ Commercial buckwheat | 2.00 |

Sowing Rate: 7 kg per acre (1.75 grams per m²)

Yellow Trefoil/ White Clover Intercrop Mixture

This mixture can be undersown into a cash crop in autumn or spring and will fill the base of a main crop brassica or cereal without affecting its yield. A mixture of species usually provides better results than just a single one. Yellow trefoil is a low-growing annual. It tolerates shade, making it ideal for undersowing and suppressing weeds within a crop. The low growing White Clover is a perfect partner, providing a second flowering plant in mid summer. Having a mixture of the two species widens the flowering window.

Yellow Trefoil/ White Clover Intercrop Mixture (MIXINT)

| | |
|----------------------------|------|
| ■ Certified yellow trefoil | 1.05 |
| ■ Certified white clover | 1.95 |

Sowing Rate: 3 kg per acre (0.75 grams per m²)

Fact

Hoverflies pretend to sting like a Wasp or Bee when provoked. This is used to scare away predators.



Perennial Wildflower Mixture

A brightly coloured perennial mixture consisting of both legumes and wildflowers. The mixture once established will flower from May – September. This mix can be sown around field margins or in strips across the field.

Perennial Flowering Insect Mix (MIXPFIM)

| | |
|---------------------------------------|------|
| ■ Certified red clover | 0.88 |
| ■ Certified late flowering red clover | 0.80 |
| ■ Certified alsike clover | 0.80 |
| ■ Certified birdsfoot trefoil | 0.64 |
| ■ Fennel | 0.40 |
| ■ Yellow trefoil | 0.22 |
| ■ Vipers Bugloss (wildflower) | 0.08 |
| ■ Ox-eye daisy (wildflower) | 0.04 |
| ■ Lesser knapweed (wildflower) | 0.04 |
| ■ Red campion (wildflower) | 0.04 |
| ■ Wild carrot (wildflower) | 0.04 |
| ■ Yarrow forage herb | 0.02 |

Sowing Rate: 4 kg per acre (1.0 grams per m²)

Long Term Grass Mixture

Strips sown across large arable fields are known as 'beetle banks'. They can also be sown along field boundaries. This mixture provides a dense, tussocky sward which gets thicker as the years go by. They may be cut two or three times in the first year for annual weed control but, once established, are cut only to prevent the encroachment of woody weeds.

Beetle Bank & Tussocky Grass Margin (MIXBB)

| | |
|---------------------------------|------|
| ■ Certified timothy | 3.00 |
| ■ Certified cocksfoot | 3.00 |
| ■ Certified red/ chewing fescue | 2.00 |
| ■ Certified tall fescue | 2.00 |

Sowing Rate: 10 kg per acre (2.5 grams per m²)

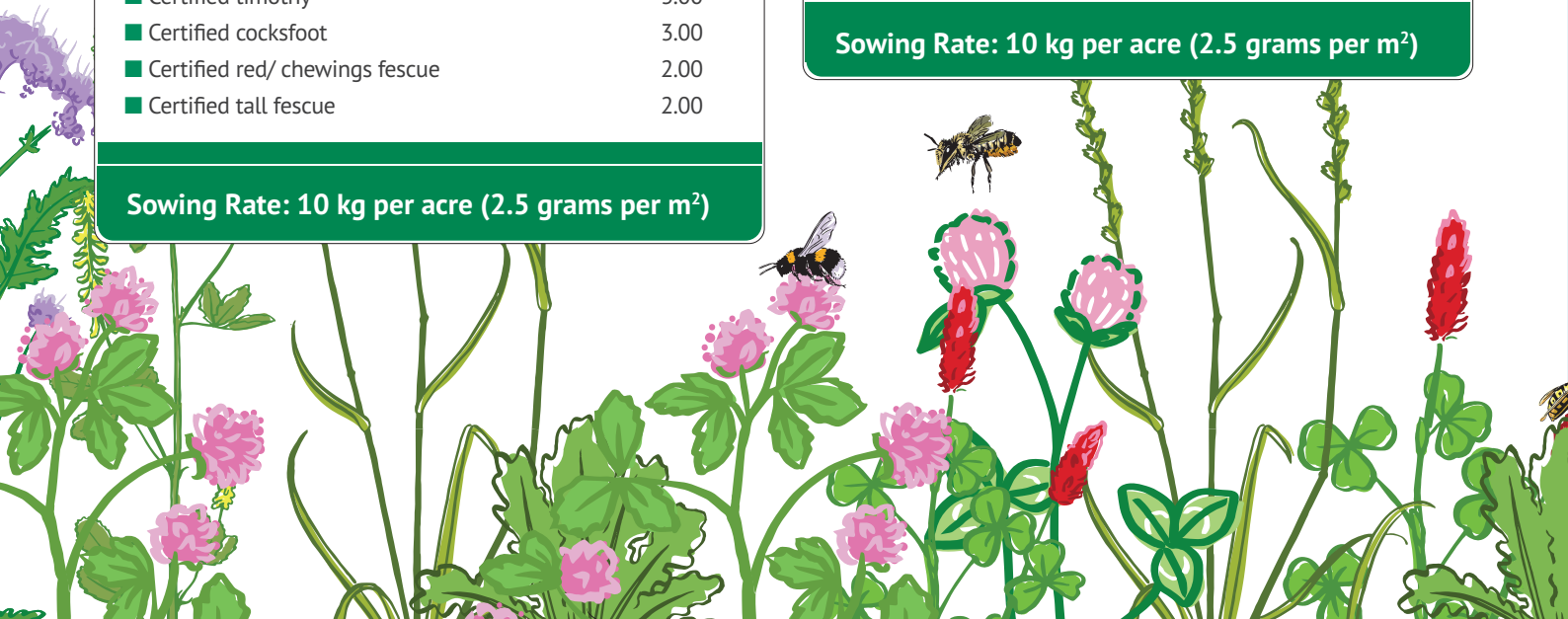
Permanent Wildflower Mixture

A very colourful mixture of native perennial wildflowers and grasses. We include annual species in the mixture to give an exceptional show of vivid colour during the first year. From the second year the perennial flower species begin to increase and just get better year by year.

Cotswold Wild Flora Mix (MIXFLO)

| | |
|--|-------|
| ■ Certified Character red/chewings fescue | 2 |
| ■ Certified Evora smooth stalked meadow grass | 1.5 |
| ■ Certified Bornito sheeps fescue | 1.5 |
| ■ Certified Southland crested dogstail | 1 |
| ■ Certified Teno smaller catstail | 1 |
| ■ Certified Highland common bentgrass | 0.5 |
| ■ Commercial Yellow Oatgrass | 0.5 |
| ■ Salad Burnet (<i>Sanguisorba minor</i>) wildflower | 0.2 |
| ■ Native Sainfoin (<i>Onobrychis viicifolia</i>) wildflower | 0.15 |
| ■ Corn Cockle (<i>Agrostemma githago</i>) annual wildflower | 0.15 |
| ■ Lesser Knapweed (<i>Centaurea nigra</i>) wildflower | 0.12 |
| ■ Self Heal (<i>Prunella vulgaris</i>) wildflower | 0.1 |
| ■ Ox-eye Daisy (<i>Leucanthemum vulgare</i>) wildflower | 0.1 |
| ■ Ribwort Plantain (<i>Plantago lanceolata</i>) wildflower | 0.1 |
| ■ Red Campion (<i>Silene dioica</i>) wildflower | 0.1 |
| ■ Ladys Bedstraw (<i>Galium verum</i>) wildflower | 0.1 |
| ■ Wild Carrot (<i>Daucus ca rota</i>) wildflower | 0.1 |
| ■ Field Scabious (<i>Knautia arvensis</i>) wildflower | 0.1 |
| ■ Corn Marigold (<i>Chrysanthemum segetum</i>) annual wildflower | 0.1 |
| ■ Cornflower (<i>Centaurea cyan us</i>) annual wildflower | 0.1 |
| ■ Field Poppy (<i>Papaver rhoeas</i>) annual wildflower | 0.1 |
| ■ Yellow Rattle (<i>Rhinanthus minor</i>) wildflower | 0.1 |
| ■ Musk Mallow (<i>Malva moschata</i>) wildflower | 0.075 |
| ■ Meadow Buttercup (<i>Ranunculus acris</i>) wildflower | 0.05 |
| ■ Yarrow (<i>Achillea millefolium</i>) wildflower | 0.05 |
| ■ Belony (<i>Stachys officinalis</i>) wildflower | 0.05 |
| ■ White Campion (<i>Silene latifolia</i>) wildflower | 0.05 |
| ■ Cowslip (<i>Primula veris</i>) wildflower | 0.005 |

Sowing Rate: 10 kg per acre (2.5 grams per m²)



Sowing & Growing Annual & Perennial Mixtures

Establishing an Annual & Perennial Field Margin & Wildflower Strip

When to Sow: Times for seeding will vary depending on the mixture used. Our Annual Insect Mix should be planted in spring from mid-April to May when soils are warm. We wouldn't advise an autumn sowing of this mix as it contains species that are not winter hardy.

The perennial mixtures can be planted either in the spring (late March to May) or in the autumn (August to mid-September).

Sowing Rate: These will vary depending on the mixture. Wildflower mixtures with grasses are generally sown at 2.5 grams per m² (10 kg per acre). Legume based mixtures with no grasses can be sown at lower rates from anywhere between 1.25–1.5 grams per m² (5–6 kg per acre). Annual wildflower mixture rates will differ 1.75 grams per m² (7 kg per acre).

Preparation: It is important to control any weeds in the area being sown before the seeds are broadcast. Problem weeds are docks, thistles and nettles as these cannot be removed easily once sowing has taken place, annual weeds are easier to deal with by topping areas in the first year if a perennial mixture is used. Planning several months ahead to clean up the area is therefore essential.

Weed control can be done in one of three ways:

1. Herbicide spray – usually a systemic herbicide like glyphosate (Roundup), which will kill any green material on the area 7 to 10 days after applying the spray. More than one spray may be needed in order to control weeds.
2. Alternatively you can try the stale seedbed technique. Prepare the seedbed as usual then wait a few weeks for weeds to germinate, then cultivate again to destroy any weed seedlings.
3. A mypex sheet or tarpaulin can be placed on the ground to kill off existing weeds several months before sowing. This is especially useful in organic systems

- Once weeds have been dealt with, prepare a fine, well-worked seedbed. This may involve ploughing or rotavating the site and cultivating it several times to work the soil down into a fine tilth.
- Firm up the seed bed by rolling the area before sowing. Small wildflower seeds do not like a fluffy, spongy seed bed. The seed can then be broadcast with a spinner or sown by hand if it is a smaller area.
- Once sown, harrow the area to give it a light soil covering and to hide the seed from hungry birds. The area should then be well rolled to ensure the seeds are in good contact with the soil.

Management: If left alone, a wildflower meadow will quickly return to scrub with the more competitive species taking over. Any wildflower meadow should be mown during its first season to control annual weeds. In the second year we recommend cutting after flowering, with the cuttings being removed where possible to avoid the ground becoming too fertile which will aid the grasses, not the wildflowers. Timing for this will vary year to year, but is normally between August and September. Annual mixtures can be destroyed at the same time as the existing crop.



Case Study

Margins & Strips at Deepdale Farm

Nathan Nelson was looking for interesting, wildlife friendly species to grow alongside his arable crops at Deepdale Farm after the entire farm went into organic conversion in 2020.

'We chose to start farming organically as it gave us a framework to focus all of our efforts on finding natural ways to improve soil health, support biodiversity and make the farm a more beautiful and healthy place to work, stay and live,' says Nathan.

He has embraced regenerative agriculture and the enhancement of the farm as an ecosystem and has introduced a diverse rotation of cash crops, as well as seed mixtures containing clover leys, wildlife margins and cover crops to support biodiversity and soil health.

60% of the farmed area is managed for wildlife, through a mid-tier Countryside Stewardship scheme. Crops are grown in 5ha plots around the farm, surrounded by the features for wildlife including 75ha of flower-rich plots, 45ha of cultivated margins and 20ha of wild bird seed mix.

There are also 2km of beetle banks to attract beneficial insects.

Beetle banks are ploughed strips less than half a metre high. They run through fields, dividing cropped plots such as spring barley which will grow on either side of the bank. Beetle banks are sown with tussocky grasses like Timothy and Cocksfoot as well as Red Fescue, Tall Fescue and flowering species such as Wild Carrot and Fennel.

'Our biggest field at 34ha is now divided into three by beetle banks, with flower-rich plots and wild bird food around cropped areas with cultivated margins.'

'A 20kg sack of Beetle Bank Tussocky Grass Margin mixture is enough for seven beetle banks stretching over 1km. The seeds are hand-sown in March or September.'

Beetle banks provide habitats for beneficial predatory beetles and other insects that help pollinate crops and reduce crop pests. They also create a lovely resource for nesting birds.

Conclusion

Using Conservation Biological Control (CBC) techniques and increasing the availability of flowers on farms can have a positive impact on ecological pest control. In addition, this approach can improve biodiversity, conservation, habitat and habitat connectivity on your farm. Other benefits include the provision of buffer function against soil erosion, pollution from pesticides and nutrients, biomass production for fodder or biogas, as well as providing pollination habitat and food for pollinators.

Conservation biological control is not a panacea, but by incorporating this technique into your farm's Integrated Pest Management (IPM) strategy it can help to reduce chemical inputs. This approach can be of benefit to both conventional and organic producers and can assist in eliminating pesticides entirely or even just save money by spraying less.

Ultimately, the information in this guide will help you to develop more sustainable ways of improving your farming landscapes as well as enhancing your native insect populations on farm. We hope that you will be able to take this practical guidance, adapt it, build on it and in turn share this knowledge with the wider farming community.

Happy farming!

Fact

A Bee's wings can beat around 190 times per second

Glossary

| | |
|---------------------------------|---|
| L.E.A.F | Linking Environment And Farming. |
| S.U.D | Sustainable Use Directive: action to achieve the sustainable use of pesticides by setting minimum rules to reduce the risks to human health and the environment that are associated with pesticide use. |
| I.P.M | Integrated Pest Management – Common sense strategies used to eliminate pests whilst lowering exposure to harmful chemicals. |
| C.B.C | Conservation Biological Control – the modification of the environment or existing practises to protect and enhance specific natural predators to reduce the effects of pests. (Source https://www.cambridge.org/core/books/abs/natural-enemies/conservation-and-enhancement-of-natural-enemies/4CFDDDDCF812C81F31C4237BE0D62705#) |
| Parasite | An organism living at the expense of another (normally as a food source) without directly killing them but harming them indirectly which can lead to death e.g. through spread of pathogens. |
| Parasitoid | Organism that when young, develops on or within another organism (host) resulting in the host's death. |
| Umbelliferous | Umbrella-like shaped clusters of flowers (relating to the carrot family). |
| Broadcast | To scatter seed by hand or machine rather than placing or with a drill in rows. |
| Larvae | The active immature form of an insect. |
| Perennial | Returns each year. Can take longer to develop. |
| Annual | Only live for one growing season. |
| Biennial | Flowers in its second season. |
| Carbon sequestration | The process of capturing and storing atmospheric carbon dioxide. |
| Systemic Herbicide | Combination of chemicals that are applied to the vegetative parts of a weed, killing it off. |
| Insecticide | Substance used to kill insects. |
| Pirate & Flower Bugs | Types of predatory insects, both are part of the Anthocordae family. They feed on insects including: aphids, spider mites and thrips. |
| Ovipositor | A tubular organ which a female insect uses to deposit eggs |
| Honeydew | A sweet, sugary, sticky substance that is excreted by Aphids onto plants leaves and stems. |



Further Reading

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