It’s not just about the bees

Insects managed correctly in agriculture transform quickly from being a pest to being a powerful tool.

For far too long the discussion in the general public around insects starts and finishes with the honey bee - even within farming the discussion is often limited to discussions about pollinators. Obviously pollinators are critical, in fact, to put some figures on how important pollinators actually are, 84% of agricultural crops in Europe and 90% of all plants on planet earth are insect pollinated. However there is an equally important role insects can play for our agricultural crops - they have the potential to be the guardians of our crops as well.

If complex insect ecosystems are allowed to develop, or, even better, proactively encouraged around and amongst our crops, an absolutely astounding sequence of events starts to unfold in front of the farmer’s eyes.

However very few farmers currently get to enjoy this great natural wonder of biodiversity. This is unfortunately because the first insect many farmers see in their fields and on their crops is either an aphid or a caterpillar; both of which are potentially commercially damaging species to vegetable farmers. This often triggers an immediate action from both conventional and regenerative farmers, who reach for any legally allowed UK chemical pesticide, as both forms of farming are only limited by national pesticide law - which is only interested in public health, not planet health. I would argue the two are inextricably linked, but apparently not, according to the current government, and to be honest every government since World War 2. The shift towards regenerative farming promises a lot for saving our soils and should be commended for this, however it is less keen to move away from agrochemicals such as weed killers and pesticides. If we are to stop and reverse biodiversity collapse as well as reduce carbon emissions in farming, then any shift must focus on to life above and below ground.

In a world where the rate of insect extinction is accelerating at an alarming rate (on the most part due to excessive agricultural insecticide use and habitat loss), this continued attitude of keeping crops clean of all insects and fields clean of all plants except the crop is no longer ethically tolerable in any form of agriculture. I passionately believe there is an alternative.

This brings me back to the astounding sequence of events that would unfold in front of all farmer's eyes if they kept their hands off the insecticides. The first thing they would notice would be the arrival of the so-called pest insects, aphids or caterpillars. However, shortly after their arrival would follow a variety of predatory insects to feast on the aphids and caterpillars. Aphids are a key protein source for ladybirds and their larvae, hover fly larvae, lacewing larvae and the larvae of parasitoid wasps. Fascinatingly, or gruesomely, depending on your attitude to these things, the parasitoid wasps lay their eggs inside aphids and caterpillars and these eggs then hatch out and consume the aphid or caterpillar from the inside before emerging. (Fig. 1)

Fig. 1 Rose Aphid (Macrosiphum rosae) parasitised by a Braconid Wasp (Aphidiinae). Bernard DUPONT from FRANCE, CC BY-SA 2.0 https://creativecommons.org/licenses/by-sa/2.0 , via Wikimedia Commons

Wherever there are aphids and caterpillars, there will be predators, as their lifecycles depend on it. However, the result of this fact is that whenever you are spraying off aphids or caterpillars with insecticides, you are also killing predators; either directly (as they are amongst the outbreaks of pests) or indirectly, by removing their food source or egg laying habitat. Due to this interaction between predator and prey, the current attitude in agriculture of reducing pesticide usage makes no logical sense, you need to allow insect populations to develop completely unhindered, only then does the real power of nature to the farmer become released. In short no aphids means no predators. There needs to be a level of tolerance of pest species, this will bring powerful populations of predators.

As alluded to above, if farmers really want to capitalise on this potent natural asset, then not only do they need to stop the use of any insecticide, they need to go completely in the other direction and actively encourage insects to thrive in amongst their crops. If they want to do this, there are critical tools at their disposal to help them boost insect populations.

Pollen

Pollen is the key currency that we farmers have to trade with insects in exchange for crop protection. The adults of lacewings, hover flies and parasitoid wasps all rely on pollen as a key source of protein. Adult ladybirds will feed on pollen in the absence of aphids or whilst trying to find them, so the idea is to create a pollen-rich habitat in and around your crops for as long a season as possible. This will ensure a constant population of adult predators on and around your crops. From this location, the adult predators are able to sense the presence of aphids and caterpillars; either by pheromones given off by the aphids themselves, or by compounds released by plants when attacked by aphids or caterpillars. Some of the predators can locate aphid outbreaks from 30 metres away. Having located relevant prey species, the adult predators lay their eggs near or inside aphids and caterpillars. When the larvae hatch out, they are immediately able to feast on prey, which enables them to build up the energy to pupate into adults and then repeat the cycle.

Fig. 2 Flower pollen. Jorge Almeida CC BY-NC-ND 2.0 https://www.flickr.com/photos/omeuceu/3160296849

There are two key sources of pollen to be used as a tool by farmers; flower pollen and tree pollen.

Flower pollen

There are over 400 different flowering plant species in the UK, some have complex flowers with specific relationships with certain insects, but many are simple flowers that are a pollen source for all insects (Fig. 2). There are many discussions about which flowers are best for attracting which insects, but I believe that when we start managing individual insect species with individual plant species, it misses the point. As discussed earlier with the interconnectedness of moths and songbirds, we need to be aiming to boost all insect life because of the highly complex interactions between many insect and other animal species, therefore we should be aiming to provide as wide a range of plants for as long a time as possible. The key distinct groups of flowering plants available to farmers to provide pollen throughout the growing season are perennial wildflowers, annual wildflowers, grasses, cover crops (crops that feed the soil and are not harvested), weeds, and the crops themselves.

Perennial wildflowers – Often seen as the most important or only source of pollen for insects. However, if left to their natural seasonal rhythms, UK wildflowers are in full abundance from May, peaking in June and July, and then slowly going to seed through August. In order to provide pollen early and late in the season, farmers need to be more creative and use other sources of pollen to keep predators nearby. There are many options, as detailed below.

Annual wildflowers (Fig. 3) – Farmers are all too accustomed with timing sowing dates to achieve a particular harvest date – we can apply the same skill to producing pollen on demand for insects. I use mixed cornfield annuals for this purpose - they tend to flower about 8-10 weeks after sowing. Flowering can be lengthened by patchwork cutting of flowers to half height after 6 weeks, this will knock some succession in to flower production. They are a key tool for me in late August, September and October, when many crops are nearing maturity such as cauliflowers and cabbages. At this stage they are particularly vulnerable to visual damage of the final product or, as in the case of cauliflowers and broccolis (calabrese), at risk of infestation from aphids or caterpillars inside the flower heads.

Fig. 3 Annual wildflowers

Grasses – Grasses do not produce nectar and are wind pollinated so not often associated with insects, however I have often seen bees and bumble bees visiting meadow foxtail to feed on the pollen in the morning. In fact, anyone with hay fever will be very aware how much pollen grass produces. Many beetles (another key predator group) feed on grass pollen too.

Fig. 4 Mixed cover crop in flower

Cover crops – An increasingly integral part of all forms of farming in the modern regenerative era, a tool that has long been used in organic farming. More often discussed as a technique for boosting soil health (with correct and diverse species selection), cover crops are another great source of pollen (Fig. 4). They can be an incredibly powerful dual tool, boosting soil ecosystems and insect ecosystems, simultaneously leading to massive increases in crop health and vigour. To achieve this, cover crops must be allowed to flower but not set seed, so should be cut or grazed at appropriate times. As with the annual wildflowers, longer flowering times can be achieved by establishing a successional cutting regime. One of my earliest large-scale sources of pollen in my cropping areas is achieved by using phacelia as an over-wintered cover crop; it protects my soil from erosion and mops up nutrients through the winter after crops such as potatoes and onions. Then in the early spring I have huge areas of flowering phacelia absolutely heaving with pollinators and predators, and when I incorporate the crop before it goes to the seed, these insects disperse all over my cropping areas.

Weeds – The aim with most of my crops is to keep them weed-free for the first 8 weeks, this then allows most crops to outcompete the surrounding plants. Once weeds have been outcompeted, they no longer become a problem, but an asset - their root exudates (sugars released by plant roots) will feed soil life, and their flowers are another varied source of pollen for insects.

Crops themselves – Allowing crops to stand in the field after you have finished harvest is another great technique for proactively managing insects. In October every year, after we have harvested all the cobs, our sweetcorn plants get covered in aphids. This a key moment in the ladybird cycle for us, we find the aphids attract large amounts of adult ladybirds (Fig. 5) which start feeding on them. More importantly, they lay lots of eggs which quickly hatch into lots of hungry larvae - these quickly feast on aphids and pupate into adults. This is when winter starts to set in and this last but important multiplication of the population heads off to the hedges, woods and other protective habitats to hide for the winter.

Fig. 5 Ladybirds feeding on aphids and pupating

Fig. 6 Insect feeding on willow

Tree pollen

Trees that produce catkins such as alder, hazel and willow are one of the earliest sources of pollen available in the UK countryside, starting in late January and running through till late March (Fig. 6). Importantly, catkins are a key source of night-time pollen for nocturnal insects such as moths, whose caterpillars in turn are a key food source for songbirds, who in turn are a key predator of cabbage white, demonstrating the inter-connectedness of all things. Catkin season runs into prunus season in late March-April which in the UK means blackthorn, cherries and plums. This is followed by a whole host of trees that come out in late April-May as the days lengthen, including hawthorn, apples, pears and many others. The end of tree pollen season is June with trees such as elder, spindle, oak and sweet chestnut producing pollen into July.

Trees are already a common feature on many farms; whether in woodlands, hedgerows or as lone trees in the middle of fields. These are all important insect habitats, but perhaps the most effective way of using tree pollen as a technique to manage predatory insects is through agroforestry where trees are intelligently integrated throughout cropping areas (Fig. 7).

Fig. 7 Agroforestry

Habitat

Whilst pollen is a vital tool for keeping predatory insects ever present around your crops during the growing season, there is another equally important tool that needs attending to, which will also help keep predators close to crops for a full 12 months of the year. That tool is a perennial undisturbed habitat, which allows predatory insects to shelter from strong wind and rain during the growing season and will also provide shelter in the winter months. Lacewings overwinter as adults, ladybirds go into dormancy as adults, and hoverflies can overwinter at any stage of their lifecycle, depending on the species. All of them require somewhere sheltered from winter weather and cold, and hedges and woodlands often provide the perfect environment. So, again, the ability to integrate trees into your cropping areas will keep predators very close and ready to leap into action as soon as the weather warms up in the spring.

Another potent habitat available to farmers is the crops themselves; those yet to be harvested, and those that have been harvested. My cabbage crops in autumn are a constant cycle of small aphid outbreaks being predated and caterpillars becoming larvae nurseries for parisitoid wasp offspring. On the underside of brassica leaves as we go into winter, we often find hover fly pupa, so all crops are left to stand for the winter (even after harvest) to provide this role of habitat (Fig. 8).

Fig. 8 Crops left as habitat after harvest

Diversity

It goes without saying that if a cabbage white butterfly flies into a field where the only plant is a cabbage, the chances of it finding a cabbage to lay its eggs on are pretty much guaranteed. If the field is packed with a huge diversity of plants, then this is likely to make the job of finding the cabbages harder. In fact this theory applies to all insect pests. Many are specialised in finding specific host plants to feed on or lay eggs on. Tools for maximising plant diversity and slowing down and confusing pests include avoiding fields of monocrops, as a field with mixed crop families will be far more resilient to insect damage. Rotation is one of the most effective tools for disrupting pest lifecycles, especially soil borne pests. Allowing weeds to come back into your crops once the crop is established, adding to diversity of flora, makes it harder for pests to find crops. Undersowing crops with green manures is another very effective way of diversifying plant mix in a field, and ideally all cover crops should be a wide diverse mix of plants too. Not only will this diversity of plants in a field disrupt pest behaviour, but it will also provide as wide a range of habitats as possible for all manner of biodiversity to live on and feed on.

The overall aim of the above strategy is to embrace the boosting of biodiversity as a powerful tool for food production, not just as a charitable exercise. I also believe that the massive necessity for high levels of tolerance involved in making this strategy work are also applicable to the way humans should treat each other, increasingly important in the divisive society we live in today.

Andy Dibben, Organic Vegetable Farmer, June 2022