Natural Enemies (Farmers' Friends)

Introduction

Beneficial living organisms which reduce pests and diseases are usually present in any crop unless broad spectrum pesticides (which kill a wide range of arthropods) have been used. These so-called natural enemies can be conserved by taking care with farming practices so that they are not killed or are actually encouraged. If numbers of such biocontrol agents are still not sufficient to keep pests at acceptable levels, it is possible to release additional beneficial organisms of the same type - a process known as augmentation or inundation. Farmers who collect ladybird beetles in field margins and release them on their crop are practicing augmentation. Alternatively if suitable types of beneficial organism are not present in the crop, they can be introduced. Where introduction involves a local beneficial organism which has simply not yet reached a particular crop, this is known as inoculation. If the introduced beneficial organism is from outside the area (typically from the country or area where the troublesome pest originated) and becomes established as the controlling factor for the pest in the new area, it is known as classical biological control. Some additional information on the importance of natural enemies in smallholder vegetable pest management is provided below.

Conservation of natural enemies

Areas of land which have not been cultivated or disturbed contain hundreds or thousands of species which tend to form a balance, with each of them depending on some of the others. Although large outbreaks of plant-eating pests do sometimes occur in natural systems, any one particular species is less likely to build up a large population if the organisms which feed on it are also present – in other words, its natural enemies. These are sometimes called farmers' friends because they help the farmer to keep pests (and some diseases) under control. Predators are one type of natural enemy which tend to keep the population of their prey in check - they catch and eat other insects and mites, including pest species. Parasitoids are another type of natural enemy - they lay eggs in or on other species of insect (called hosts) and the larval stage kills the host as it feeds on it and develops.

When crops are grown, it inevitably disturbs the natural balance, especially where the crop is a monoculture i.e. all one species of plant. However, the beneficial effect of predators and parasitoids continue to be critically important.

If they are correctly managed, they will help prevent some of the pest problems which farmers encounter. An example of how farmers can help to keep the balance in their favour is to try not to harm predatory insects such as ladybirds, spiders and hoverfly larvae which feed on plant-eating pests such as aphids and caterpillars. These predators can be found on most crops together with parasitoid wasps (and occasionally parasitoid flies) which lay their eggs in/on pests. In IPM systems which aim to minimise dependence on pesticides, it is essential that the farmer can distinguish these natural enemies from pests and can use farming techniques which will conserve and encourage natural enemies.

Like humans, insects also suffer from diseases which can weaken or kill them. Types of fungal, bacterial and viral pathogens which only affect insects and are safe for humans and animals have been identified. Some of these are commercially produced as biopesticides and some can be prepared on the farm.

Augmentation and inundation with natural enemies

Sometimes there are predators and other natural enemies present which are feeding on the pests, but they are not able to control them effectively, particularly those pests that are capable of breeding very quickly. Farmers can augment the number of natural enemies by bringing them in from outside the field, for example, ladybird beetles or parasitized aphids which contain young parasitoids. Some types of natural enemy can be specially bred in large numbers, and then released onto the crop in order to attack and control the pest. The natural enemies inundate the pest population. Many of the advances in this technique have been against pests of crops which have been economically important for a long time, such as cotton. for example, the egg parasitoid wasp called Trichogramma has been bred in laboratories to allow huge numbers to be released when eggs of the African bollworm are present on the crop. The same bollworm can be a serious pest of tomatoes, so it may be possible to use the same biocontrol tactics developed for cotton. Aphid parasitoids could theoretically be produced and released in a similar way, but these technologies are often not yet available to small-scale vegetable growers.

Using insect pathogens in pest control sprays

Naturally-occurring pathogens that kill insects (fungi, bacteria and viruses) can be obtained from diseased insects and incorporated into sprays applied to control the pest. This is a type of inundation. Pathogen-based sprays are not yet widely available for vegetable pests except for Bt (Bacillus thuringiensis) a bacterium which kills larvae of moths and butterflies (caterpillars). One example under development is a virus which kills diamondback moth caterpillars - a serious pest of brassicas. The pathogen is called Plutella xylostella granulovirus (PlxyGV). The pathogen has the important advantage of being highly specific. In other words it does not harm other arthropods such as natural enemies so it works together

with the natural processes which limit pest numbers. This contrasts with most pesticides which also kill natural enemies. Farmers sometimes use a type of home-made biopesticide - they gather diseased pests, crush and mix them with water, then spray the liquid onto the crop. The fungi, bacteria or viruses which were infecting the collected pests will infect other pests in the crop and kill them.

Important natural enemies or 'farmers' friends'

Ladybird beetles

The adults and larvae of ladybird beetles are important predators of aphids. A single ladybird can eat 200-300 aphids over its lifetime. The adults are typically dome-shaped and orange or red coloured with black markings or spots (Picture). The larvae look quite different and are usually longer and thinner (a little like tiny spotted crocodiles), coloured black or dark brown with various types of light markings (Picture).

Ladybirds can be encouraged by growing non-crop plants which support aphid species which do not attack crops, for example, thistles and milkweed. They can also be brought in by hand from outside the crop. Spraying with pesticide should be avoided wherever possible in order not to kill the ladybird adults and larvae but if it is necessary, selective methods should be used (see CS4R4).

Ladybird adult, showing typical red wing cases with black spots

Ladybird larva, showing typical 'crocodile-like' shape and light markings

Hover flies

Adult hover flies usually have black and yellow stripes on their abdomens (Picture) and they can often be seen hovering (staying in one place in the air) to feed on nectar from flowering plants. Although adults help to pollinate plants, it is the larvae which are most useful since they are natural enemies of aphids and small caterpillars. They look a little like pest caterpillars but are more tapered with pointed heads (Picture). Some common species appear wet (slimy) on the outside of their bodies and are easy to recognize as they move their pointed heads up and down and from side to side searching for prey.

Hover flies can be encouraged by allowing non-crop plants such as milkweed and thistles to grow around fields - these support non-pest species of aphids that hover fly larvae can feed on. Flowering plants such as the spice crop coriander can be planted so that adult hover flies are attracted to the food source of nectar and pollen. In rape and kale, some of the previous crop can be left to flower (provided the pest and disease levels are low) or a small number of plants from the current crop can be encouraged to bolt and flower by stopping watering. Avoid spraying with pesticide whenever possible but if it is necessary, use selective methods (see CS4R4).

Hover fly adult, showing typical yellow stripes on flattish abdomen

Hover fly larva, showing typical tapering head end

Parasitoid wasps

These are small wasps, usually black, which lay eggs inside or on other insects such as aphids and caterpillars, or even in the eggs of other insects. The picture shows a parasitoid wasp laying an egg in an aphid. When the egg hatches the larva of the parasitoid feeds on its host and kills it. The other picture shows parasitized aphids call aphid mummies, which have turned brownish and hard when the wasp larvae pupated inside them.

Parasitoid wasps can be attracted and sustained by ensuring that there are flowering plants nearby to provide nectar for them to feed on. They can also be encouraged by providing non-crop plants such as milkweed and thistles which encourage non-pest species of aphid. Avoid spraying pesticide unless absolutely necessary since adult parasitoid wasps walk around a lot on the leaves while searching for hosts so can quickly pick up a harmful quantity of pesticide.

Parasitoids wasp laying eggs in aphids

Parasitised aphids known as 'mummies'. They appear hard and brown.

Predatory mites

These eat plant-feeding mites. They are very small (less than 1mm) and difficult to see by eye but if populations of red spider mites are examined closely, any predatory mites present can be identified by their longer legs and much faster movement.

They can provide effective control of spider mite populations on tomatoes but it can take some time for numbers to build up, especially if the plant variety has very sticky stems and leaves. Most predatory mites cannot survive without live prey to feed on, so hedges and living fences and other non-crop plants can help to provide a refuge and food source for them between crops. Dust tends to kill predatory mites so regular irrigation, which reduces dust, will tend to encourage these natural enemies. Also, colonies of plant-feeding mites can be kept on potted plants and when predatory mite numbers build up they can be transferred to the crop. In some countries the mites are commercially available for releasing onto the crop (a type of inoculation).

Ants

Some ants are generalist predators, in other words they attack many different types of prey. They can be very effective at removing caterpillars and other pests from crops - they are thought to be one of the most important natural enemies of Helicoverpa armigera - the African bollworm. Excessive hoeing or ploughing will destroy ant nests so farming systems which use minimum tillage (very little hoeing or ploughing) are more likely to encourage beneficial ants.

However, some species of ant also protect pests - in particular they stop natural enemies attacking aphids in order to maintain their supply of honeydew – the sugary liquid excreted by aphids as they suck the plant sap, and which the ants use as a food source.

There are many other natural enemies, such as spiders, bugs, predatory wasps and mantids which play a vital role in regulating pest numbers.

'Safari' ants carrying a diamondback moth caterpillar after clearing it from a kale plant

Antagonistic micro-organisms

There are cases where one micro-organism will suppress another. For example, if a harmless species of fungus become established on a crop, it may prevent the establishment of some types of harmful fungal pathogens on that crop. It is possible to spray spores of the harmless fungus to prevent the harmful disease fungus, but this technique is not commercially available to small-scale producers. However, Trichoderma is a fungus which is sometimes used as a seed dressing to prevent other fungi from damaging the seedling.

Some brassicas can be infected with black rot but may not suffer much damage or yield loss. This is because antagonistic bacteria are also living in the plants and can prevent the black rot becoming serious. Unfortunately, there is no easy way for smallholders to make use of these antagonistic bacteria on other types of brassica.