BBC BITESIZE

Hello, I'm Dr Alex Lathbridge and this is Bitesize Biology.

This is the final episode in a six-part series about Infection and Response. In this episode we're going to talk about plant disease and what physical and chemical defences plants have against pathogens.

We've already spoken about the four different types of pathogens that cause disease: viruses, bacteria, fungi and protists. If that doesn't sound familiar, go back to episode 1 of this series on BBC Sounds and take a listen.

Remember: pathogens have very simple life cycles: they infect a host, reproduce many times (or replicate if they're a virus) and then leave their host to infect other cells or organisms.

So far we've mostly talked about what happens when pathogens invade the cells and bodies of humans. When pathogens invade the cells of plants, they can reduce their growth or even kill them.

And that can lead to a reduction in biodiversity. To be clear, that's bad.

Pathogens that target plants that humans use for food crops are especially serious, for example the Irish Potato Famine in 1850, was caused by a mould that destroyed tomatoes and potatoes, and this lack of food led to starvation that killed over one million people. This is important stuff.

Let's take a look at two examples of pathogens that target plants, you need to know the names of these, and how they are spread and what the treatments are. So grab a pen:

First up, the Tobacco Mosiac Virus. This was the very first virus to ever be identified. This affects the tobacco plant (as well as other closely related species like tomatoes and peppers.) It's transmitted by direct contact from one plant to another, either naturally or spread on the hands of farmers. It infects the chloroplasts of plant leaves and leaves a mosaic pattern on the leaves, hence the name. So what it does is it discolours their leaves, and that reduces the amount the plant can photosynthesize. This has a knock-on effect on reducing the plant's growth, and so farmer's yields, the amount that they can produce, are reduced too.

A second example is rose black spot, which is caused by a fungus. It can spread through the air, in water or through direct contact on gardeners' hands. Rose plants develop purple or black spots. The leaves can turn yellow and then they can drop off, reducing photosynthesis and growth. It can be treated through fungicides, which are chemicals which kill fungi, and by destroying any infected leaves.

But pathogens aren't the only things that damage plants. Let's not forget about insects and the damage they can do.

You might have heard of something known as aphids. Aphids are tiny greenflies that infect rose and tomato plants. They are found in large numbers on the shoots and stems of plants and they suck sap out of them. Plants need water and nutrients to survive so sucking this sap out slows the growth of plants and can eventually kill them.

To get rid of aphids, gardeners often try to have lots of ladybirds in their gardens, because ladybirds like to eat aphids, and this is a natural way of getting rid of them, rather than using chemicals.

Now let's take a look at the defence systems of plants. Because, like humans, plants have both physical and chemical barriers.

Remember these three physical defences of plants:

1. Trees have bark, which is actually a layer of dead cells which surrounds the plants to form a physical barrier against infection.

2. Each plant cell has a cellulose cell wall which is another tough barrier that protects against pathogens.

3. Leaves are covered in a waxy cuticle, which is like a protective layer of waxy skin. The leaves are where the all-important photosynthesis happens so it's important to keep the cells in this area protected with a physical barrier.

And there's also these chemical defences:

Humans have our enzyme-filled tears and stomach acid, plants have something a bit different.

Plants like mint and witch hazel produce antibacterial chemicals (a bit like antibacterial handwash that we use.) These reduce the spread of bacteria that get past the physical barrier.

Stinging nettles have developed poisons to stop them being eaten by herbivores (animals that only eat plants). If you've ever been stung by stinging nettles, you can imagine why that sting would put off an animal eating them. But the poison from stinging nettles can only get them so far, the poison doesn't help with infection from pathogens.

And also remember chili peppers. The reason why they make your mouth burn is because of a chemical called capsaicin. This affects mammals but birds don't feel that burn. Their mouth doesn't have the receptor to feel the chemical. This evolved to prevent mammals from eating them but birds have no problem, because birds fly can really really far and poop out the plant seeds, thereby spreading them far and wide, which is a good thing.

Another thing to remember is that farmers can now genetically engineer plants that are resistant to disease. We'll be talking about that process in much more detail in our series on inheritance, variation and evolution.

So that's physical defenses and chemical defenses. But unlike humans, plants also have mechanical defences.

What does that mean?

Have you ever tried to eat a rose? Roses are covered in thorns and hairs. Likewise, cacti have thin spines. These adaptations stop the plants from being eaten and damaged, so that's one mechanical defence.

A second mechanical defense is drooping leaves. The mimosa pudica plant has evolved the ability to close its leaves and point its stems down towards the ground, like limp spaghetti whenever an insect lands on it, which then makes it really difficult for the insect to then eat the leaves.

Finally, mimicry. Some plants have evolved the ability to mimic (or look like) their surroundings, to stop themselves from being eaten. The passion flower vine has small yellow spots on its leaves, which look really similar to butterfly eggs. Butterflies can't tell the difference between real eggs and the passion flower leaves, so they lay eggs on leaves away , to avoid competition with these pretend eggs. Because no eggs are laid on them, the passion flower leaves are less damaged because no feeding caterpillars are born on them.

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