# Detection and identification of plant diseases

4.3.3.1 · Infection and response · revision notes

How to tell that a plant is diseased, how the cause can be identified, the plant pathogens and pests you need (TMV, rose black spot and aphids), and the effects of nitrate and magnesium deficiency. This subtopic is GCSE Biology only (not Combined Science).

## Key facts

- Signs of disease: stunted growth, leaf spots, rot, growths, malformed stems or leaves, discolouration, pests
- Examples: TMV (virus), rose black spot (fungus), aphids (insects)
- Magnesium ions → chlorophyll; lack → chlorosis
- Identify: gardening manual or website, laboratory, monoclonal antibody testing kit
- Nitrate ions → protein synthesis; lack → stunted growth
- Chlorosis = yellowing of leaves caused by a lack of chlorophyll

## Notes

### Signs that a plant is diseased

- **Stunted growth**, **spots** on leaves and areas of **decay** (rot).
- **Growths**, and **malformed** (abnormally shaped) stems or leaves.
- **Discolouration**, e.g. yellow or pale patches on leaves.
- The presence of **pests**, e.g. insects on the stems or leaves.

### Identifying the cause

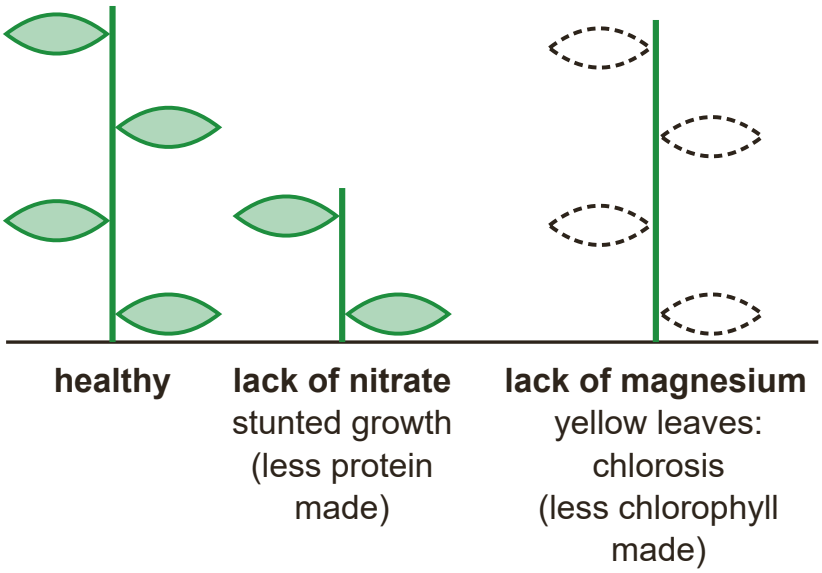
- Compare the symptoms with a **gardening manual** or **website**.
- Take infected plants to a **laboratory** to identify the pathogen.
- Use a **testing kit** containing **monoclonal antibodies**. The antibodies bind only to one specific pathogen, so a positive result identifies it.

### Pathogens and pests

- Plants can be infected by viral, bacterial and fungal pathogens, and damaged by insects.
- **Tobacco mosaic virus (TMV)**, a virus: a mosaic pattern of discolouration on the leaves.
- **Rose black spot**, a fungus: purple or black spots on the leaves, which turn yellow and drop early.
- **Aphids**, insects: they push their mouthparts into the phloem and feed on the sap, taking sugars the plant needs. They can also carry viruses from plant to plant.

## Mineral ion deficiencies

- Plants can also be damaged by a lack of mineral ions in the soil. These **ion deficiency** conditions are not caused by pathogens.
- **Nitrate** ions are needed for **protein synthesis**. A lack of nitrate causes **stunted growth**.
- **Magnesium** ions are needed to make **chlorophyll**. A lack of magnesium causes **chlorosis**: the leaves turn yellow. With less chlorophyll there is less photosynthesis, so the plant grows less.




Dashed leaves are yellow (chlorosis).

- A deficiency can be put right by adding a fertiliser that contains the missing ion.

## How to answer each type of question

**Recall: signs of disease and how to identify it**

1 to 3 marks | **Grade 4**

1. Learn the seven signs of disease from the specification.
2. Learn the three ways to identify a disease: manual or website, laboratory, testing kit.

**Example.** (a) Give **two** signs that a plant may have a disease.
(b) Give **one** way a gardener could identify the disease.

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**Model answer.**

(a) Any two from: stunted growth, spots on leaves, areas of decay (rot), growths, malformed stems or leaves, discolouration, presence of pests (1) (1)

(b) Any one from: look it up in a gardening manual or on a website; take the plant to a laboratory; use a testing kit containing monoclonal antibodies (1)

### Explain the effect of an ion deficiency

3 marks | Grade 5

1. Say what the ion is used for (nitrate → protein; magnesium → chlorophyll).
2. Give the symptom (stunted growth; chlorosis).
3. Link to growth or yield.

**Example.** A crop was grown in soil that lacked magnesium ions.
Explain why the crop had a low yield.

**Model answer.** Magnesium ions are needed to make chlorophyll (1). So the leaves have less chlorophyll and turn yellow (chlorosis) (1). So less light is absorbed for photosynthesis, and less glucose is made for growth (1).

### Explain how an insect pest affects a plant

2 marks | Grade 7

1. Say what the pest removes or damages (sap from the phloem, containing sugars).
2. Link to less sugar for the growing parts of the plant.

**Example.** Aphids are insects that feed on the sap in a plant's phloem.
Explain why a plant with many aphids grows slowly.

**Model answer.** The aphids remove sugars from the phloem (1). So less sugar reaches the growing parts of the plant for respiration and to make new cells (1).

### Explain how a testing kit identifies a pathogen

2 marks | Grade 7

1. Say that the monoclonal antibodies are specific to an antigen on that pathogen.
2. Say what you would see if the pathogen is present (a coloured line or colour change).

**Example.** A grower thinks some tomato plants are infected with tobacco mosaic virus (TMV).
Explain how a testing kit containing monoclonal antibodies could confirm this.

**Model answer.** The monoclonal antibodies bind only to a specific antigen on TMV (1). If TMV is present in a sample from the leaves, the antibodies bind to it and a coloured line or colour change appears (1).

## Don’t lose marks

- Swapping the two ions: magnesium is for chlorophyll, nitrate is for protein synthesis.
- Writing 'the plant can't photosynthesise' for magnesium deficiency. Photosynthesis is reduced, not stopped.
- Calling an ion deficiency an infection. It is caused by a lack of mineral ions in the soil, not by a pathogen.
- Confusing chlorosis (yellowing of leaves) with chlorophyll (the green pigment) or chloroplasts (where photosynthesis happens).

Answering 'how could the disease be identified?' with 'look at the plant'. Give a method: manual or website, laboratory, or testing kit.

## More tips

### Memory tricks

- Mg for green: magnesium makes chlorophyll, so a lack of it gives yellow leaves (chlorosis).
- Nitrate → protein → growth, so a lack of nitrate gives stunted plants.
- Seven signs of disease: stunted, spotted, rotting, growths, malformed, discoloured, pests.

### Exam technique

- For deficiency questions, give the full chain: ion → what it is used for → symptom → effect on growth.
- Use the evidence in the question to decide between causes, and say which evidence supports your choice.
- When a testing kit is mentioned, link it to monoclonal antibodies and their specificity.

## What each grade needs

What you need to be able to do, from the first marks up to the top grade.

**Grade 4** — **List signs that a plant is diseased**
Stunted growth, spots on leaves, areas of decay (rot), growths, malformed stems or leaves, discolouration and the presence of pests.

**Grade 5** — **Describe ways to identify a plant disease**
Use a gardening manual or website, take the plant to a laboratory, or use a testing kit containing monoclonal antibodies.

**Grade 5** — **Give examples of plant pathogens and pests**
Tobacco mosaic virus (a virus), rose black spot (a fungus) and aphids (insects).

**Grade 5** — **Explain the effect of magnesium deficiency**
Magnesium ions are needed to make chlorophyll, so leaves turn yellow (chlorosis) and photosynthesis falls.

**Grade 6** — **Explain the effect of nitrate deficiency**
Nitrate ions are needed for protein synthesis, so without them growth is stunted.

**Grade 7** — **Explain how aphids damage plants**
Aphids feed on sap from the phloem, removing sugars that the plant needs for growth.

**Grade 8** — **Use symptoms to suggest a likely cause**
Link the evidence to a cause, e.g. purple or black spots suggest black spot, then say how to confirm it.

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