



BOTRYTIS

Botrytis cinerea: agent of the grey mould in cyclamen. It is an airborne fungus.

An omnipresent pathogen, the grey mould of ornamental plants can contaminate a wide number of species, including the cyclamen. It is particularly dangerous with cyclamen grown under glass as this provides ideal microclimatic conditions for the development of the fungus.

I – SYMPTOMS

At the heart of the plant:

Botrytis is characterised by a soft mould, often hidden by vegetation, which covers and softens the heart of the plant by directly affecting the base of the flower and leaf stems. The base of the bulb is covered with grey mould which also reaches the young leaves and flower buds.

It develops more easily in those areas of the plant where it can find dense foliage.



This type of infection often leads to the total loss of the plant.



On the leaves:



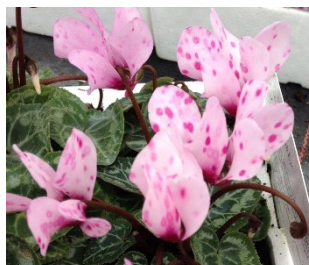
The symptoms (large brown marks) visible on the picture on the left are rare as the adult leaves have harder tissues, are further away from the risky area and more aerated, therefore more difficult for the fungus to reach.

These symptoms are more frequent on dead tissue.

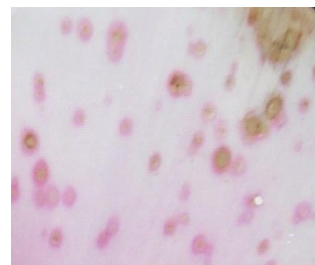
For example, an infected flower can fall and contaminate a healthy leaf.

On the flowers:

Description of the symptoms and evolution of the disease



1 - Small round marks develop on the petals without any visible sign of fungal fructification (grey mould). On varieties with white or very dark flowers, these marks are almost invisible.



2 - These marks are surrounded by a purple ring on coloured varieties and by an aqueous ring on white or very dark-flowered varieties.

3 - They become brown and rot as the fungus develops.

This phase might be the only one visible on varieties with white or very dark flowers.



II – PROPAGATION

Botrytis cinerea is a **weak, unspecialized parasite**.

An isolated spore is generally not capable of invading, on its own, a leaf or a healthy stem. The germ tube produced by the spore can only penetrate the epidermis thanks to a wound (leaf scar for example) or lesions caused by other diseases.

On the cyclamen, it **develops primarily in autumn and winter**.

The factors contributing to propagation:

- ✓ wounds or lesions due to other diseases
- ✓ dried, ageing or withered leaves
- ✓ mycelium growing in nutrient-rich organic matter in contact with host tissues
- ✓ the presence of a film of water on the leaves or high levels of humidity
- ✓ insufficient light
- ✓ water increases the adherence of affected organs to healthy tissues, which can potentially lead to higher propagation

Once in place, the fungus multiplies actively by fructifying to release spores (conidia) which appear as fuzzy grey mould on diseased organs.



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II – PROPAGATION (*continuation*)

These spores are the source of numerous secondary contaminations.

Thanks to a powerful arsenal of enzyme weapons, the fungus progresses rapidly inside the plant by attacking healthy tissues. Overfeeding with nitrogen or an unbalanced feed will favour the fungus. Infection is stimulated by the decrease of nutrients in the leaves.

Climatic conditions facilitating the germination of the spores:

- relative humidity of 95% for 3 to 4 hours
- A temperature around 20°C/68°F (but infection is also possible in temperatures ranging from 2 °C/35°F to 30°C/86°F)

III – PREVENTION

Prevention essentially involves **controlling the % relative humidity** which should be below 85% notably in order to avoid the leaves and flowers becoming wet.

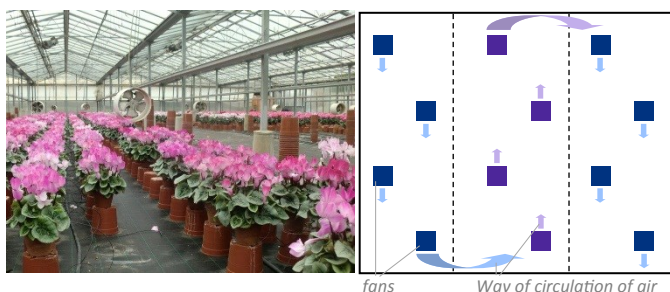
Different strategies for controlling the humidity in greenhouses:

1 - air movement

The main method remains **ventilation** which enables the hot and humid air inside the greenhouse to be exchanged with the drier and colder or cooler air from outside.

When the plants are in flower in autumn and winter, especially in colder and wetter regions, ventilation must be combined with heating to avoid significant and sudden drops of temperature. This technique leads to higher energy costs.

Air mixing (using fans) combined with ventilation for greater effectiveness. The aim is to avoid the stagnation of the air in the centre of the greenhouse or the creation of layers of hot air in the higher parts of the greenhouse and cold air near the cyclamens. There are many different types of fans available but the most common are circulating fans to be staggered in each unit of the greenhouse. Each unit should blow air in the opposite direction to the unit next to it (see picture and diagram below).



Climate management software for greenhouses enables air mixing and heating to be controlled and combined with precision, switching them on and combining them only when necessary.

2 - watering

Localised and the most precise **irrigation systems** possible are recommended, in order to avoid wetting the foliage notably in regions with a humid climate and to ensure that the substrate close to the bulb is permanently dry.

Examples of good root systems with a substrate zone near to the bulb permanently dry:



Using subirrigation, the watering duration (speed for filling / emptying the table), the substrate and the design of the pot are determining factors in ensuring the top of the pot is kept dry. As the photo shows, the capillaries have developed in the lower half of the pot, the water not having risen to the bulb.

Using drip irrigation, lower flows of around 1l/hour offer precise watering with controlled drainage. The roots will develop on the lower 3/4 of the soil keeping the upper 1/4 close to the bulb remaining permanently dry.

Note that drippers without plants left on the ground will increase the level of relative humidity in the greenhouse.



The precise **management** of watering is also very important.

In the autumn-winter flowering period (high risk period), the need of transpiration of plants decreases; they need less water. Watering should be adapted accordingly, becoming less frequent. The volume of water of each watering, if it was adapted to obtain the desired plant growth, remains the same, but the frequency decreases.

This decrease helps to prevent the increase of the relative humidity rate in the greenhouse as the plants absorb almost all the water given; there is only a small surplus which could evaporate into the air, condensate with the drop in temperatures and wet the plants.

Healthy and abundant capillary roots are the result of controlled and efficient watering during the vegetative growth phase.

During the flowering phase, it is always these roots that absorb the water and the different nutrients which it contains. The more capillaries there are, the less surplus water and the greater the plants' capacity to absorb the elements which they need (fertilizer, trace elements, etc.).

If the root system is damaged, there is an additional risk of water stagnation and thereby an increase in the relative humidity. Moreover, the plants lose their capacity to absorb elements, which might result in them becoming weaker, thereby increasing the potential for the development of any disease.



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III – PREVENTION (*continuation*)

3 - Fertilisation

This is a form of indirect prevention. Fertilisation must be based on the precise **control of nitrogen** doses, always given in the form of nitrates rather than ammonium or urea. The nitrogen / potassium hydroxide ratio must be between 1:2 and 1:3. In fact an overdose of nitrogen, notably ammonium or urea, accelerates the vegetative growth, leading to an increased demand for water. Controlling the watering management in this case is difficult.

Moreover, nitrogen in the form of ammonium or urea tends to soften the plant's tissues, thereby facilitating the development of grey mould.

It is also recommended to gently remove withered leaves and flowers taking care not to cause lesions to the bulb. When removing dead flowers, take care not to damage the bulb. Ensure you remove all the flower or leaf stalks.

If there are a few millimetres of stems left near the bulb, the soft tissues of the bulb will soon become infected.

IV – PREVENTION / CHEMICAL CONTROL

Prevention should be given priority over the use of chemical control methods.

Existing active ingredients for controlling Botrytis do not guarantee success. That is why it is important to combine their action with adapted growing techniques (see section III - Prevention).

Prevention / chemical control present a certain number of constraints:

- ✓ risk of phytotoxicity
- ✓ product approval varying from one country to another
- ✓ increasing resistance of the fungus

The active ingredients presented below generally offer good results. It is recommended to alternate them to better counter the increasing resistance of the fungus.

Active ingredient	% Ingredient	Spraying doses	ULV sprayer doses
Cyprodinil / Fludioxonil <i>Preventive - Curative</i> <i>Systemic</i>	37,5% 25%	60 - 100 g/Hl	0,8 Kg/Ha
Iprodione <i>Preventive - Curative</i> <i>Contact</i>	500g/l	100 – 150 cc/Hl	1,5 L/Ha
Pyrimethanil <i>Preventive - Curative</i> <i>Contact</i>	400g/l	150 - 200 cc/Hl	2L/Ha
Fenhexamid <i>Preventive</i> <i>Contact</i>	50%	80 - 100cc/Hl	1kg/Ha

Systemic active ingredients are less effective when they are used with ULV systems. With ultra-low volume systems contact products will be more effective.

On the other hand, using the spraying techniques, both types of active ingredients (systemic and contact) show the same level of effectiveness.

During the prevention period, when there is a low risk of the fungus developing, it is possible to really wet the plants and thereby increase the effectiveness of the active ingredients. However, in high risk periods (high humidity), wetting the plants represents an additional risk, the objective being always to keep them dry.

It is strongly recommended to treat the plants in the morning in order to give them enough time to dry before night fall.

If the disease appears to be progressing rapidly, increase the frequency of the treatments, without changing the recommended doses. Consult the instructions for use of each product.

WARNING: consult your local plant protection agency to ensure that you are complying with the latest regulations and directives concerning the use of phytosanitary products.

V – IN CASE OF INFECTION

It is clear that prevention is essential.

However, in the case of infection, some measures can be taken, the first being to reduce the level of relative humidity in the greenhouse.

It is also recommended to increase the frequency of chemical treatments.

If the flowers are infected, it is also possible to remove all the flowers on the plant to prevent the disease spreading. New flowers will not necessarily be infected.

To treat a severe attack at the heart of the plant, spray the active ingredients listed above directly onto the infected parts.

If these operations, which are very labour intensive, cannot be carried out, it is essential to remove any infected plant in order to avoid the disease spreading from one plant to another.