CULTURE INFORMATION

The new classification of the Morel series by flower and pot sizes is accompanied by a new technical information: the average daily temperature (ADT). These are the thermal conditions under which varieties give the best results at the flowering stage.
It provides a measurable factor to the determination of the "Ideal sales period according to climate".

			Pot size Ø in in.	Ideal sales period for climate type: South				North				Advised ADT° at flowering stage* in greenhouse	Plants yard²	Culture time in weeks from sowing
MINI flower size	2.5 ~ 4" Ø	Smartiz® Smartiz® VICTORIA The VICTORIA characteristics are more pronounced when days are long	2.5									54 ~ 59°F	42	27 ~ 28
			3.5									59 ~ 68°F	34	
			4									68 ~ ≥ 77°F	25	
		Metis® FANTASIA®	2.5									54 ~ 59°F	42	30 ~ 32
			3.5									59 ~ 68°F	34	
			4									68 ~ ≥ 77°F	25	
	3.5 ~ 5" Ø	Metis®	3.5									54 ~ 59°F	25	28 ~ 29
			4									59 ~ 68°F	21	
			5									68 ~ ≥ 77°F	17	
		Metis® SILVERLEAF	3.5									54 ~ 59°F	25	29 ~ 31
			4									59 ~ 68°F	21	
			5									68 ~ ≥ 77°F	17	
		Metis® VICTORIA The VICTORIA characteristics are more pronounced when days are long	3.5									54 ~ 59°F	25	28 ~ 30
			4									59 ~ 68°F	21	
			5									68 ~ ≥ 77°F	17	
		Metis® PomPom®	3.5									54 ~ 59°F	25	30 ~ 32
			4									59 ~ 68°F	21	
			5									68 ~ ≥ 77°F	17	

			Pot size Ø in in.	Ideal sales period for climate type: South				North				Advised ADT° at flowering stage* in greenhouse	Plants yard²	Culture time in weeks from sowing
MIDI flower size	3.5 ~ 5" Ø	Tianis® FANTASIA®	3.5									54 ~ 59°F	25	30 ~ 32
			4									59 ~ 68°F	21	
			5									68 ~ ≥ 77°F	17	
	4 ~ 5" Ø	Tianis®	4									54 ~ 68°F	21	27 ~ 29
			5									68 ~ ≥ 77°F	17	
	4 ~ 6" Ø	Premium	4									54 ~ 59°F	17	27 ~ 29
			5									59 ~ 68°F	13	
			5.5									68 ~ ≥ 77°F	12	
		Latinia® FUNFLAME® Latinia® FANTASIA®	4									54 ~ 59°F	17	30 ~ 32
			5									59 ~ 68°F	13	
			5.5									68 ~ ≥ 77°F	12	

These growing periods are observed in Fréjus (France) with the growing techniques described on our web site www.cyclamen.com.
Please contact us for the adjustments to make according to your localization.

In this respect, Smartiz® for example will be advised to be produced in 2,5" pots if the flowering period corresponds to a cooler period, winter or spring in all regions, and also in autumn in Northern climate type. On the other hand, if produced in 4" pots, it is advised that the flowering period coincides with a warmer period, summer for all regions and also autumn in Southern climate type (temperatures of 68° ~ ≥ 77°F).

			Ideal sales period for climate type										
			South				North						
		Pot size Ø in in.									Advised ADT* at flowering stage* in greenhouse	Plants yard²	Culture time in weeks from sowing
MAXI flower size	4 ~ 6.5" Ø	**Latinia® SUCCESS® and Flamed mix**	4								54 ~ 59°F	17	28 ~ 30
			5								59 ~ 68°F	13	
			5.5								68 ~ ≥ 77°F	12	
		Latinia® VICTORIA *The VICTORIA characteristics are more pronounced when days are long*	4								54 ~ 59°F	15	29 ~ 30
			5								59 ~ 68°F	12	
			5.5								68 ~ ≥ 77°F	10	
		Latinia®	4								54 ~ 59°F	15	28 ~ 30
			5								59 ~ 68°F	12	
			5.5								68 ~ ≥ 77°F	10	
	5 ~ 6.5" Ø	**Hallos® FANTASIA®**	5								54 ~ 59°F	12	32 ~ 34
			5.5								54 ~ 68°F	10	
			6.5								54 ~ 68°F	5	36 ~ 38
		Hallos® VICTORIA *The VICTORIA characteristics are more pronounced when days are long*	5								54 ~ 59°F	12	30 ~ 32
			5.5								54 ~ 68°F	10	
			6.5								54 ~ 68°F	5	34 ~ 36
		Hallos® HD	5								54 ~ 59°F	12	32 ~ 34
			5.5								54 ~ 68°F	10	
			6.5								54 ~ 68°F	5	36 ~ 38
	5.5 ~ 8.5" Ø	**Hallos® SILVERLEAF Hallos® BLUSH**	5.5								54 ~ 68°F	8	32 ~ 35
			6.5								54 ~ 68°F	4	36 ~ 39
			8.5								54 ~ 59°F	3	38 ~ 41
		Hallos®	5.5								54 ~ 68°F	8	32 ~ 35
			6.5								54 ~ 68°F	4	36 ~ 39
			8.5								54 ~ 59°F	3	38 ~ 41
		Hallos® FANTASIA® SILVERLEAF NEW	5.5								54 ~ 68°F	8	31 ~ 33
			6.5								54 ~ 68°F	4	35 ~ 37
			8.5								54 ~ 59°F	3	37 ~ 39
		Hallos® CURLY®	5.5								54 ~ 68°F	8	35 ~ 37
			6.5								54 ~ 68°F	4	38 ~ 40
			8.5								54 ~ 59°F	3	40 ~ 42

54 ~ 59°F	Cold culture conditions to obtain plants with small volume or to reduce the transpiration of the plants with large volume. Mind the humidity. These temperatures request varieties with low sensitivity to Botrytis.
54 ~ 68°F	Cold to cool culture conditions, ideal for most of the large flower types (Halios®) in a standard pot of 5.5 to 6.5" (14 - 17cm)
59 ~ 68°F	Cool culture conditions, ideal for most of the mini and intermediate varieties in standard pot of 3.5 to 5" (9 to 12 cm).
68 ~ ≥ 77°F	Warm culture conditions to obtain plants with a larger volume than normal, with high performance during culture and at the consumer's.

Legend :

* ADT at flowering stage: Average Daily Temperature advised in greenhouse at flowering stage

CULTURE PLANNING

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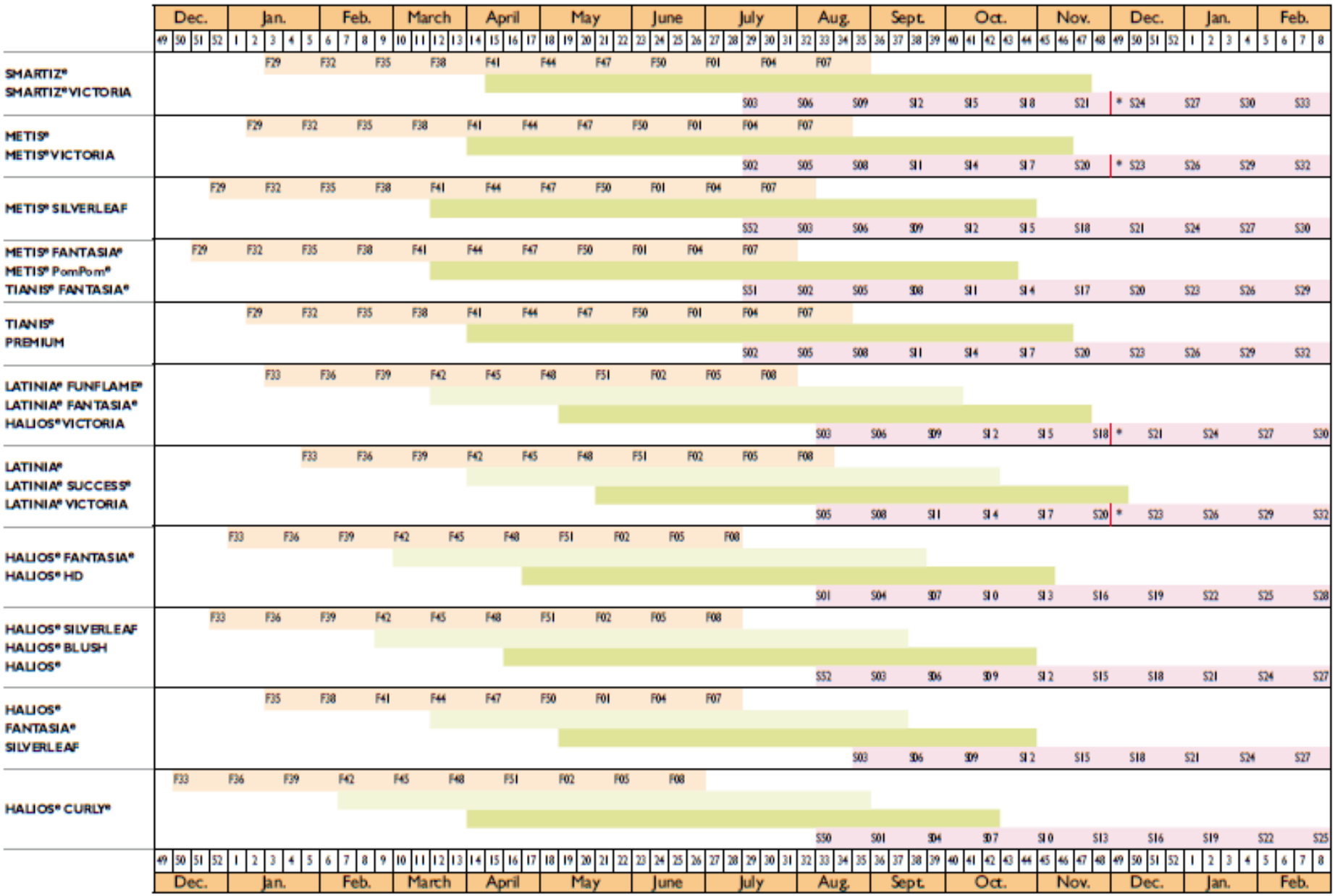

To keep the VICTORIA characteristics clearly marked, we advise not to exceed this flowering period.

These growing periods are observed in Fréjus (South of France) with the growing techniques described on www.cyclamen.com.
Please contact us for the adjustments to make according to your localization.

S = Sowing F = Flowering Sowing Transplanting Potting Flowering

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Cyclamen growing can be divided into 3 distinct stages each with their own objectives: rooting, growth and flowering. The success of the latter depends on the success of the previous two. The aim of rooting is to create the best conditions for the seedling's roots to colonise the pot properly. This stage is demanding for the seedling and can cause major strain. Various environmental and growth conditions and growing systems can affect the success of this decisive stage.

I - YOUNG PLANTS

A - Young plants features and care.

A good young plant that's ready to be potted should have healthy roots and enough of them for good regrowth in the new substrate. For best results, use seedling extraction trays which are readily available from your suppliers.
When potting, half or a third of the bulb should be visible with good contact with the substrate as well as a good setting in the plug.

"Direct planting" seedling

transplanted young plant

Young plant trays can be stored in the fridge at 10/12°C for a few days. There are risks of slowing down the young plant's regrowth and rooting at lower temperatures and longer durations. A young plant that's been dehydrated for a long time before being potted will never produce the same quality roots as a well-tended young plant.

B - Plug size/Pot size

The main essential rule of potting is to respect the size of the plug compared to the size of the pot to avoid suffocation when the freshly potted plug is first watered. The following table is an indicative guide for the size of the pot, different sizes of plugs, diameters and volumes.

Pot size Ø in cm	Ø plug in mm	Average age of young plant	Plug Volume cc=cm³	Indicative* timing for rooting stage	Tray 50x30cm (cells number)
6 to 9	16/17	10 weeks	4-5	4 weeks	400-500
10,5	18/22	10/12 weeks	6-8	4 weeks	200-300
12	22/28	12/14 weeks	10-20	5 weeks	100-200
14	30/40	14/16 weeks	25-40	5/7 weeks	60-100
17	30/40	14/16 weeks	25-40	7/8 weeks	60-100

* Watering systems and substrate recipes can affect the rooting duration.

For pots ≥ 19 cm : plan a supplementary stage					
Pot size Ø in cm	Ø plug in mm	Average age of young plant	Plug Volume cc=cm³	Indicative* timing for rooting stage	Tray 50x30cm (cells number)
(in pot of 9/11 cm) = intermediate potting	18/22	10/12 weeks	6-8	4 weeks	200-300
pots ≥ 19 cm	9/11 cm	14/16 weeks	250/500	8/9 weeks	

Some plugs can have the same diameter but a larger volume if the plug is deeper. We highly recommend this type of plug for potting cyclamen because it has a better buffer effect and achieves more roots guaranteeing excellent regrowth.

Please note that all the plug must be in contact with the new substrate without burying the bulb. Often, the excessive pressure of watering can make the young plant jump out or bury it.

II - CLIMATE CONTROL

A - Setting up a site for rooting

The site for the rooting stage must be disinfected to ensure healthy growth.

We highly recommend putting the pots on the ground for the rooting stage in hot countries or during summer (ADT* >25°C) to maintain the substrate's temperature and humidity. However, there must be a small space between the ground and the pots to avoid water pooling which creates a drop in temperature when it evaporates e.g. when the ground isn't flat. In this respect, you can use raised pots or carry trays with a raised base.

Lifted growing tray

Good rooting helped by the lifted tray

The effect of different surfaces must be considered during this stage such as concrete as there can be significant drops in humidity in summer which disrupts the substrate's buffer effect and slows rooting down.

Open benches with a grid often produce an overly ventilated site and can stop successful rooting. Carrying trays or other protective systems are required to stop excess ventilation.

Because of the importance of this first stage, there should always be a dedicated rooting area away from the growth area so the different growth factors can be monitored.

B - ADT/maximum light

The ideal temperature recommended for rooting is around 18-20°C Average Daily Temperature (ADT) with a maximum light intensity of 400 W/m² of radiation.

The rooting stage can last longer in some cases:

- Below 18°C, for certain varieties and large pot sizes, rooting stage can last far too long and the plant can stay then too small at flowering stage.

- With very warm growing conditions (ADT > 25°C) and /or maximum light < 300 W/m², the rooting stage may be extended but for better result.

***ADT Average Daily Temperature

ADT* (Average daily temperature)**	<15-18 °C in W/m²	18 -20°C in W/m²	20-25°C in W/m²	>25°C in W/m²
Maximal light	500	400	350	<300

*During summer, depending on the climates, night temperatures fluctuate a lot and this heavily effects the average daily temperature in the greenhouses

In order to control shade according to the ADT, especially in summer, we highly recommend whitening the outside of greenhouses and using screens inside based on the maximum light intensity.

Ventilation systems should be used to remove excess humidity created by watering.

III - WATERING CONTROL

A - How watering systems perform

During the rooting stage, an efficient overhead watering system should include two basic features: consistency and an adjustable flow in order to adapt water quantities to pot sizes.

Water booms have these features. They "sweep" over plants with a water curtain and exceptional consistency as well as control of speed and angle to better penetrate the pots and apply the amount of water correctly and uniformly.

Water boom

Sprinkler systems water plants in circles and by gravity. These are two disadvantages as they cause layered and irregular watering areas. Cyclamen's umbrella-shaped foliage also limits how much water reaches the substrate.

Watering by hand with fine spray head nozzle that create an ultra-soft shower is recommended and better than sprinklers for simpler-equipped greenhouses.

B - Watering criteria

Whatever the watering method, the right shading needs imperatively to be adapted to the ADT. The aim is to protect a stable growth environment and maintain the substrate's humidity.

Remember to avoid an excessive dehydration of the pot that would result growers to water too deeply and too much.

Always keep in mind that the weak point of the young plant is the root system, not the foliage.

Excess watering during rooting

Once potted, initial watering should be heavy to make the substrate's humidity consistent. Subsequent watering should be lighter but regular. In practice, the entire pot shouldn't be watered but just to enable the humidity to reach the bottom of the pot by diffusion. Be careful not to let the bottom of the pot dry out too much.

Good rooting

Even during the hot periods, it is not recommended to use frequent, light and quick watering by hand to cool down the foliage as it softens the cyclamen and slows rooting down. It also increases the risk of developing diseases such as Anthracnose or Erwinia.

IV - FERTILISATION

A - Starting charge fertiliser

A starting charge fertiliser of around 1kg/m3 should be enough for feeding requirements throughout the rooting stage for most varieties and growth conditions.
To encourage rooting, fertiliser should not be used if the roots haven't reached all the substrate as salts in the fertiliser can accumulate and restrict growth, especially in warm climates. That's why we recommend watering using clean water free of fertiliser and acid even if the water pH needs to be corrected.

Excess fertiliser during rooting

B - Slow-release fertiliser

Regular slow-release fertilisers are not recommended. These fertilisers are released faster, before rooting and often in too big quantity.
This effect is even amplified in hot areas.

Nethertheless, in areas with cool climates, with very low doses and very slow release they could be used with caution.

Please note that most of these formulas contain excess amounts of ammonia nitrogen (NH4) too high for growing cyclamen.

V - GROWTH REGULATOR

When young plants regrow, growth regulators treatments can block both growth and consequently, the rooting. The best time to spray them, if necessary, would be at the end of rooting just before spacing.

Blocked plant due to growth regulator.

BOTRYTIS

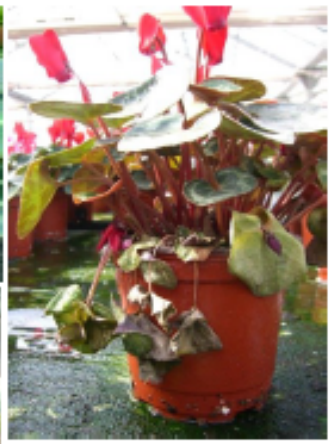
Botrytis cinerea: agent of the grey mould in cyclamen. It is an airborne fungus.

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.

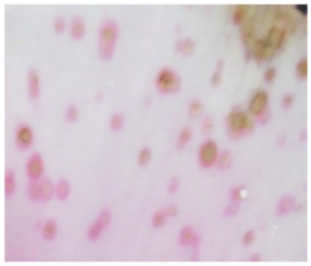
On the leaves:

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 an 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 .

For more information, see the detailed technical factsheet on www.cyclamen.com / professional area

BOTRYTIS

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*)

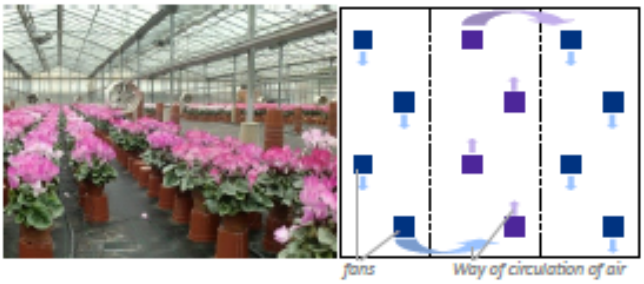
III – PREVENTION

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 keepin 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.

For more information, see the detailed technical factsheet on www.cyclamen.com / professional area

BOTRYTIS

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 *Preventive - Curative Systemic*	37,5% 25%	60 - 100 g/Hl	0,8 Kg/Ha
Iprodione *Preventive - Curative Contact*	500g/l	100 – 150 cc/Hl	1,5 L/Ha
Pyrimethanil *Preventive - Curative Contact*	400g/l	150 - 200 cc/Hl	2L/Ha
Fenhexamid *Preventive Contact*	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.

For more information, see the detailed technical factsheet on www.cyclamen.com / professional area

FUSARIUM

Fusarium is a vascular disease due to a fungus present in the soil, *Fusarium oxysporum f. sp. Cyclaminis*

I – SYMPTOMS

The external symptoms are not immediately detectable. Therefore an infected plant will sometimes be difficult to detect but will nonetheless be a lethal source of contamination.

Manque d'eau *Fusariose*

The most common symptom is a lateral and partial wilting of the plant due to an infection of some vessels. In general a yellowing appears in the centre of the leaves irrigated by the infected vessels.

Warning, the yellowing of the leaves can be caused by other reasons than fusarium.

To confirm this infection, just cut the tuber cross-sectionally and look for the presence of brown/orange spots obstructing the vessels on one side of the plant.

Less frequently, depending on the humidity and temperature levels, white and pinkish fruiting bodies may develop from the necrotized areas of the tuber towards the stems. This is a way of spreading spores.

At the start of the infection, the roots can stay healthy then become putrefied as the disease progresses.

Plants can be affected whatever their age. However, the more adult they are (just before and during flowering), the more visible and dramatic the symptoms are.

II – PROPAGATION

Fusarium oxysporum produces 3 kinds of spores: microspores, macrospores and chlamydospores. Micro and macrospores spread through the air by infecting healthy plants, while chlamydospores can remain in the soil for years waiting to attack the roots.

Each stress factor during growing may foster the plant's sensitivity to Fusarium:

- Contamination is more important when **temperatures are high** (optimal 28 °C/82.4°F), especially in summer.
- **The water from watering system** plays a leading role in spreading chlamydospores, either by splashing, or by flow.
- **Tools, a substrate, pots, trays and other objects** infected by previous cultivations or which have been in contact with an infected plant, may also be the cause of the contamination.
- **Excess nitrogen** (especially ammonia) **in** the summer can cause a water imbalance and stress the root system.
- **Cultivations** that are too dry and too bright can accelerate the damage caused by the disease.

Once the disease has been declared, infected plants have to be thrown away immediately. Up to this date, there is no effective treatment. The only solution is good prevention and balanced cultivation. Preventive treatments also exist.

III – PREVENTION

Cleaning and disinfecting are the first precautions to take.

Cultivation in direct contact with the ground (soil) represents a high risk of contamination, even if insulated with a geotextile membrane, (they are still permeable). In fact, even the most efficient disinfections will only reach the first few centimeters of the ground surface. Chlamydospores may be present deeper down and resurge at any time.

It is strongly recommended to use non-porous surfaces such as plastic and to avoid wood or soil.

Irrigation mats (3 layers) offer a good guarantee. They are thin and disinfecting them is very effective. In addition, their lower layer is waterproof and ensures good insulation.

Plants with damaged roots are will be more likely to be contaminated, even with a low infection rate. Warning, a crop that is too dry or too moist weakens the small capillary roots.

IV – CHEMICAL PREVENTION

Some active ingredients provide a powerful disinfection:

- Sodium hypochlorite
- Peracetic acid
- Quaternary ammonium
- Benzoic acid

V – BIOLOGICAL PREVENTION

Biological prevention consists of inoculation with other antagonist fungi which permits to fight directly against the pathogen:

- By destroying their cell membranes by using enzymes
- By occupying their living space through competition to absorb their nutrients.

Fuspiu® and Trichoderma are very effective antagonists to *Fusarium oxysporum*. They can be used in conjunction with a good initial disinfection and a balanced cultivation.

VI – CHEMICAL CONTROL

Controlling the spread of this disease using chemical combat does not offer a cure at the moment. Some fungicides demonstrate more efficiency on plants grown without stress and if all the preventive precautions have been followed correctly.

In some trials, the following active ingredients have had positive results:

- Azoxystrobin
- Fludioxonil

In the case of treatment of the substrate, please contact your suppliers in order to ensure yourself of the compatibility of these active matters with antagonistic mushrooms.

WARNING: check with your local branch for plant protection to find the latest updates to the regulations and guidelines for using phytosanitary products.

CYCLAMEN LEAF BURN AND FLOWER NECROSIS

Necrotic spots (on the leaves and sometimes also on the rim of the flower petal) may be caused by a physiological imbalance between insufficient uptake through the root system during periods of high evaporation by the foliage and the flowers.

Temporary increased water requirements are often caused by a sudden increase in light or temperature. In case the **root system** is **not fully developed** or **damaged**, they may not supply the plant with enough water.

As the plant's youngest tissues are the most vulnerable they require the most water and a temporary insufficient water supply can lead in to damaged leafs and flowers.

This cause and effect relationship tends to occur in the advanced growth stages: just before or during flowering.

Spots on flowers

Spots on leaves and flowers

How to prevent them ?

- **Plan** the variety's flowering period based on their vigor, pot size and recommended ADT (Average Daily Temperature). Use your **technical leaflet** for further information.
- Respect the **rooting period** at the start of the culture to get sufficient, well-functioning and healthy roots spread evenly throughout the root zone.
- Set shading set points according to ADT. In autumn, periods of sudden temperature variation can lead to incorrect watering which can be the cause of significant root loss.
- Avoid high salinity and excesses nitrogen levels to avoid excessive growth. **Avoid nitrogen** sources containing ammonia or urea .
- Use a balanced fertiliser formula at a N/K_2O ratio of 1:2 or 1:3. Incorporate sufficient **calcium** levels with the feeding (between 50 and 100 mg/L).
- Use a **tailor made substrate** to meet the requirements of the watering system (drip irrigation or sub-irrigation) with a sufficient drainage capacity yet enough water buffering capacity for the small capillary roots.
- If using **terracotta pots**, monitor excessive draught stress as root loss is more likely with terracotta pots than with plastic pots.
- Use plastic pots that block light from the root zone in hot climate zones. Light entering the root zone will damage roots and reduces the amount of capillary roots.
- During periods of short days, do not exceed 80-85% **relative humidity** in order to keep plants active in transpiration to enable the uptake and transport of nutrients through transpiration.

NITROGEN IN THE CULTIVATION OF CYCLAMEN AND MOREL GENETICS

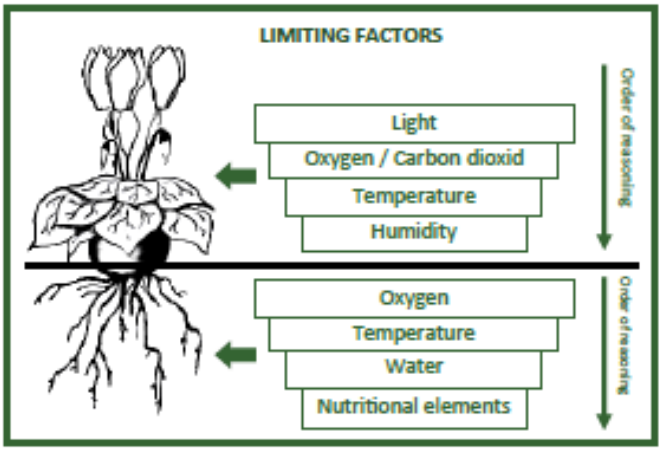
Nitrogen plays a predominant role in cyclamen cultivation and must be adapted according to the different growth factors and the chosen genetic solutions.

What are these different factors and how do they interact with the effects of nitrogen?

I – VEGETATIVE GROWTH

A - Limiting factors

The cyclamen's growth depends on basic factors. If some are lacking, growth is limited. It is important to prioritise these factors according to their limiting aspect as the plant's yield potential is determined by the most limiting element.



Light is the 1st limiting factor. If there is insufficient light it will be difficult to plan a cultivation. However, in most growing programs, light levels are significantly higher than those needed by cyclamen.
Consequently, we usually talk of maximum radiations or of % shade. Cases of insufficient natural light and cultivation requiring added artificial light are rarer.

B - The balance and hierarchy of growth factors

Among the growth factors, some are more important than others and must be considered as priorities. Looking for the perfect fertiliser recipe is pointless if the basic elements such as temperature, light, humidity and water are not sufficient and balanced.

What is the order of priority of these elements?
It was presented in the growing recipe tables of the previous Extra-large cyclamen and Halios® HD TechNews factsheets. Always assuming sufficient light levels, the first element to consider is the ADT* in the greenhouses (for more details see the ADT* TechNews), followed by light control, then the irrigation which must be adapted to the temperature. The light is controlled thanks to the different shading techniques, the irrigation thanks to its frequency and the quantity of water provided with each watering.
An optimal balance between these elements enables the transpiration of the cyclamen to be controlled and results in compact and continuous but unforced growth, without any damage to the fragile root system.

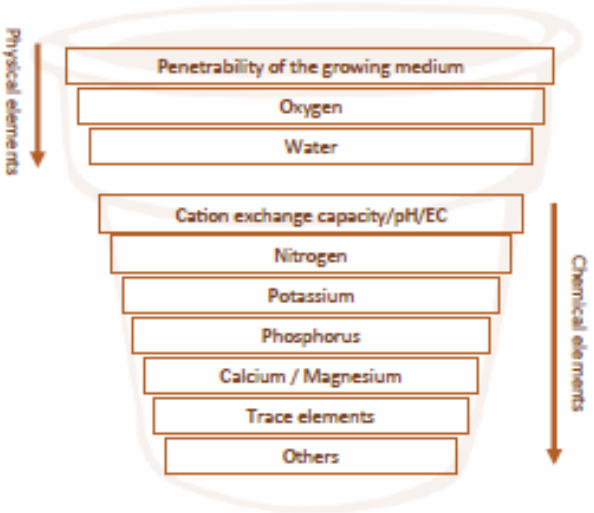
Humidity is sometimes difficult to control and the techniques to put in place can be expensive. However, precise watering can help to prevent excessive levels of hygrometry.

In the order of priorities, fertilisation should be the last factor to take into account because it can be easily adapted depending on the priority growth elements and the choice of the different Morel genetics solutions.

II – NITROGEN AND FERTILISATION

A - Nitrogen and the vegetative growth of the cyclamen

In the growing medium the main limiting factor, before water, is the availability of oxygen to the roots. Before considering the chemical limiting elements, it is essential to take into account the physical elements of the potting soil in order to ensure that the root system is able to breathe.



To obtain controlled growth, nitrogen is the most limiting factor of the nutritional elements, generally serving as a reference value with which the others must be balanced.
It acts as an accelerator or a restraint to growth in the cultivation of potted plants.

Due to its own physiology and its rate of growth, the cyclamen requires 50% less nitrogen than other cultivated species.

Ornemental species	Nitrogen input in ppm per watering
Morel F1 Cyclamen	75 to 100
Chrysanthemum	150 to 200
Poinsettia	150 to 200
Vegetative petunia	150 to 200
Pelargonium	150 to 200

*ADT - Average Daily Temperature - in greenhouse

NITROGEN IN THE CULTIVATION OF CYCLAMEN AND MOREL GENETICS

B - The role of potash

Potash is another key element. It counteracts the nitrogen by acting on the opening and closing of the stomas thereby regulating the transpiration of the cyclamen in periods of high temperatures. N/K_2O balances approaching 1/3 are recommended in order to obtain firm tissues, thereby improving resistance to various diseases.

C - The different sources of nitrogen

There are 3 main sources: fertiliser, the methods to regulate pH levels and the residual nitrates in the drilling water.

- **Fertiliser**: whether it is in a compound or simple fertiliser, we recommend a nitrogen input in nitrate rather than ammonium or urea form which accelerate growth and the need for water.
- Nitric acid (HNO3) is used to **regulate the pH** of nutrient solutions when the water has a high level of alkalinity. If the level is too high it is recommended to use alternative acids such as phosphoric acid (H3PO4) or sulphuric acid (H2SO4) in order to prevent excessive nitrogen input from the acid.
- In some agricultural areas, the **drilling water** can contain high levels of residual nitrogen in the form of nitrates.

In order to determine the amount of nitrogen input which is really necessary, it is essential to carry out a full analysis of the water and an overall assessment of the 3 possible sources.

III – NITROGEN AND MOREL

During the phase of vegetative growth, more or less nitrogen will be absorbed depending on the growing technique (ADT*/ shade/ water balance) and will have a different impact depending on the chosen genetic solution and the size of the pot.

The type of growth of the different series is summarised in the following table.

	Growth *less reactive to Nitrogen*	Growth *more reactive to Nitrogen*
Mini Flower	Smartiz® Metis® FANTASIA® Metis® silverleaf	Smartiz® VICTORIA Metis® Metis® VICTORIA Metis® PomPom®
Midi Flower	Tianis® Tianis® FANTASIA® Premium ABANICO® Latinia® FUNFLAME® Latinia® FANTASIA®	Premium
Maxi Flower	Latinia® SUCCESS® Latinia® VICTORIA Halios® FANTASIA® Halios® VICTORIA Halios® HD	Latinia® Halios® silverleaf Halios® BLUSH Halios® Halios® FANTASIA® silverleaf Halios® CURLY®

IV – NITROGEN AND ADT* DURING THE GROWTH STAGE

The table below shows nitrogen values in ppm depending on different ADTs* (during the growth stage) and the genetic solutions. They should be taken into account when growing in standard-sized pots.

ADT* / ppm N**	15° to 18°C	18 to 20°C	20° to 25°C	> 25°C
Genetic solutions *less reactive to Nitrogen*	≥ 100	75 to 100	50 to 75	25 to 50
Genetic solutions *more reactive to Nitrogen*	75 to 100	50 to 75	20 to 50	25

***Nitrogen doses expressed in ppm = parts per million or mg/litre*

To sum up, the higher the temperature, the less nitrogen required whatever the type of genetic solution.

BEWARE of sudden temperature changes. It is strongly recommended that you keep an eye on the weather forecast and adapt the nitrogen doses accordingly.

Standard pot sizes per Morel genetic solution

For example, here, for a growth stage ADT of 18-20°C

Morel Solution	∅ pot	Morel Solution	∅ pot
Smartiz® Metis® FANTASIA®	9 cm	Latinia® SUCCESS Latinia® VICTORIA Latinia®	12 cm
Smartiz® VICTORIA Metis® Metis® silverleaf Metis® VICTORIA Metis® PomPom® Tianis® FANTASIA®	10,5 cm	Halios® FANTASIA® Halios® VICTORIA Halios® HD	14 cm
Tianis® Premium ABANICO® Premium Latinia® FUNFLAME® Latinia® FANTASIA®	12 cm	Halios® silverleaf Halios® BLUSH Halios® Halios® FANTASIA® décora Halios® CURLY®	17 cm

The flexibility of each solution enables varieties to be grown in smaller or larger pot sizes. The nitrogen doses should then be adapted.

V – NITROGEN AND IRRIGATION

A basic principle to always bear in mind is that the nutritional elements are absorbed through the capillary roots. A good root system leads to better absorption of the nitrogen and other elements impacting directly on vegetative growth.
Root development is mainly linked to water management. Therefore, in order to obtain, on the one hand, the desired vegetation volume and on the other, the root/vegetation surface necessary for healthy plants, it is essential that the watering is both precise and adapted. More and more irrigation systems are now available and are becoming increasingly accurate: low-flow drippers, fast filling and draining ebb and flow systems, ultra-thin watering mats offering minimum flow rates.

Allowing the growing medium to get too dry between waterings can result in a lack of vegetation growth. Be careful if using breathable clay pots, as they allow around 50% of the water to evaporate instead of being absorbed by the roots.

**ADT - Average Daily Temperature in greenhouse*