

Cultivation manual

Dendrobium nobile pot plant

Cultivation

Substrate

The substrate for the cultivation of *Dendrobium nobile* should consist of organic mixtures with a good draining capacity such as bark (medium-coarse), coconut chips or a mixture of both. An addition of 10 to 15% peat fibre, sphagnum moss or coconut fibre improves the moisture-retaining capacity. There has been a trend towards finer mixtures in the past years to prevent Lyprauta flies from hatching their eggs within the pot. If you use a finer mixture, the fertilising and irrigation method must be adjusted in comparison to substrates that mainly consist of bark.

Temperature

The optimal temperature for the different phases is as follows:

	Minimum Night	Target value Day
Cultivation phase	24 °C	26 °C
Maturing phase short day	23 °C	25 °C
Cooling phase	12 °C	18-22 °C
Growing-on into flowering	16 °C	20-22 °C

Lighting

- **Cultivation phase**

The lighting values must not be higher than 20,000–25,000 lux when the young plants start to grow, after which you should increase these values to a maximum of 35,000 lux. On average, 300–350 PAR (= $\mu\text{mol m}^{-2} \text{s}^{-1}$) is needed for optimal growth. If the lighting values become higher, then screening or light chalking is necessary. During the cultivation phase, a long day of 14-16 hours is typical to create sufficient spikes on the plant.

- **Maturing-flowering phase**

The maximum lighting values are between 30,000–40,000 lux ($500\text{--}700 \mu\text{mol m}^{-2} \text{s}^{-1}$). This level is best measured above the plant (also applies to the cultivation) by a continuous measurement with a PAR metre connected to the climate computer. At higher values, the screening should be closed, or a thin layer should be chalked after which the screening can make it even darker. The lighting values may be significantly lower during the cooling. It is common to implement a short day of 8-10 hours for the duration of these phases. In this way, you create an artificial autumn/winter. Generally speaking, the natural flowering period of *Dendrobium nobile* is in spring. In a greenhouse, this process can be achieved year-round, so flowering will also take place in winter, summer and autumn.

Water

Water is one of the most important elements of cultivation. Only rainwater or reverse osmosis (RO) water is suitable. Each other water type irrevocably leads to problems in the cultivation in the long term. Ensure a sufficient amount of water storage. It is to be expected that the water usage, including draining through the crop, can be up to 15 litres of water per m² a day on warm days. It is important to adjust the water supply method per cultivation phase. At the start phase, the water application rate will be fewer litres and also during cooling, the irrigation rate will decrease. The water certainly must warm up sufficiently during the winter period. The minimum temperature is 12°C. If the temperature of the irrigation water is lower, several growth problems may occur. Higher values are not a problem provided they remain under 22 °C. A reverse flow device or heated basin in the barn is necessary.

Relative humidity

Good air humidity is important for a good growth and flowering phase of *Dendrobium nobile* in which the optimal values are between 50 and 80%. It is not necessary to achieve the desired values 24 hours a day. Higher values than 80% are acceptable without problems. In this case, it is necessary to ensure that sufficient moisture will be drained away.

Dendrobium can withstand lower relative humidity values well. But RHs that are too low (under 50%) and CO₂ concentrations that are too high (above 1000 ppm) will squeeze the stomata which will affect the assimilation. If you use a mist installation, increasing the RH therefore has advantages.

CO₂

During the hours that the plant is receiving light, the plant should have sufficient CO₂. A level between 400 and maximum 800 ppm is then sufficient. Make sure to start dosing when the lighting is on.

Fertilising

The fertilising in the cultivation phase is (20–20–20) + (calcium nitrate) + (bittersalt) in the ratio 6:3:1; with 0.75–1.00 g/l or 0.75–1.00 EC. In the maturing phase (from SD to cooling) fertilise with 0.25 g/l or 0.25 EC with 7-11-27 + CaNO₃ and alternate with clean water. In the short day (maturing phase) and cooling phase, it is essential to use little or none fertiliser. Carefully increase fertiliser again in the growing-on and flowering phase provided the buds are already present. This should be done to obtain a better foliage colour on the plants if necessary. When using too much fertiliser, there is a risk that flower buds change into shoots. That is what is called a keiki.

Flowering induction plan

Planning the flowering period of *Dendrobium nobile*:

Cooling period

October–November
November–December
December–January
February–March
June–July

Flowering period

December–January
January–February
March–April
May–June
September–October

Using a short day (SD) treatment, the growing spike can be stopped to create a 'cane' after which it should mature. Fertilising is then stopped or significantly reduced. After initial growth of the latest leaf, the plant should - depending on the variety - mature for another 4 to 8 weeks before cooling. The total short day period will therefore be 12 to 18 weeks (sometimes even 20 weeks), depending on the variety. The tip should become hard, spherical and lighter in colour and often turns slightly yellow. This is essential to achieve a good flower bud formation from top to bottom in the cane.

The flower formation takes place on a mature spike ('cane') at a minimum of 6 weeks 14°C night temperature. Flowering is achieved 6 to 8 weeks after the cooling period of - as said - also 6 weeks at a mean temperature of 20 °C. Count on 12 weeks until flowering plants from the start of the cooling. Delaying is possible by maintaining a lower temperature during the growing-on phase. Generally speaking, the flower colour will become more intense at temperatures under 20 degrees and it improves the shelf life.

At a natural cycle without lighting and SD section, *Dendrobium nobile* should be potted between January and April (Northern hemisphere). Let them grown on and mature from the longest day without fertilising until the plant is ready for the cooling phase. Transfer early flowering varieties to a cooler section from October onwards, the later flowering varieties only after December and January. For the rest of the assortment, the same information is applicable as mentioned earlier.

Pests and diseases

The following pests and diseases can occur in *Dendrobium nobile* cultivation with reference to cause and effect:

- Foot and root rot.

Foot and root rot can take place at high humidity, poor ventilation, poorly draining potting soil and a high electric conductivity (EC) in the pot (this can be corrected with clean water or water with a very low EC). We recommend the use of a fungicide in the case of foot and root rot. Cultivating less humid is also an option, but the substrate should always remain damp. Otherwise, there is a chance the cane will shrink or dry out.

- Western flower thrips.

Western flower thrips can cause foliage and flower deformation as well as flower spots. By spraying the plants or the greenhouse with several insecticides, degradation can be prevented and combatted. Biological methods have also been developed increasingly. This is often a matter of preventive introduction. Keeping the air vents (more) closed when the neighbours are going to mow their lawn or clear their crop - if possible - is also recommended. By now, several thrips have been identified in the horticultural sector. It is very likely that several varieties of thrips can cause damage to *Dendrobium nobile*. Insect mesh can also help to keep this plague more under control.

- Brevipalpus (false spider mite).

Brevipalpus discolours the underside of the leaf. A spraying treatment with acaricides is recommended.

- Spider mite.

See Brevipalpus. Spider mite can be combatted biologically with several predatory mites such as *Neoseiulus californicus*, which can also work against Brevipalpus, along with *Phytoseiulus persimilis*.

- Scale insects and wealy bug

Scale insects and wealy bugs can be combatted by spraying with several insecticides. The predatory beetle *Cryptolaemus montrouzieri* can be used against wealy bug. This beetle looks very similar to the wealy bug, so do not mistake them with each other. To combat scale insects, ichneumon wasps are available.

- Caterpillars.

Combat feeding holes in the foliage by caterpillars with several pesticides. Population development is to be seen with light traps (scout!). Only turn on lights if the screening or air vents are closed, so you minimise the attraction of moths from outside. The number of moths often increase in the autumn around week 34 to 40.

- Leaf spot (*Phyllosticta*).

Leaf blotch is caused by high air humidity or a shortage of nutrition. This can be combatted by drying out and possibly spraying with a fungicide. Fertilising sufficiently - and not too rich in nitrogen (ureum!) - in the cultivation phase, can contribute to the prevention of leaf spots. Make sure the crop dries sufficiently quickly, so don't water 24 hours a day. A wetting agent can be useful in the winter and autumn months. Please note that if there are very many canes per m² the crop is not too crowded and air movement/drying will stagnate.

- 'Pot worm' (Lyprauta larvae).

'Pot worm' is caused by a substrate that is too wet. To use biological control by spreading Macro-mite (*Macrocheles robustulus*) directly during potting can be useful. Ensure that the substrate in the pot dries off sufficiently quickly or irrigate less water. Combat the flies by spraying the greenhouse.

For the use of pesticides and dosage, you are best to consult an expert and recommend that you read the label properly. When using a new method, always perform a test in a small area first.

Greenhouse set up

Section

To grow *Dendrobium nobile* pot plants, it is necessary at least four sections are available at the site:

1. Cultivation phase: 35% of the surface (18-20 weeks)
2. Short day: 35% of the surface (12-18 weeks)
3. Cooling phase: 15% of the surface (6 weeks in the greenhouse or 3-4 weeks in cell cooling)
4. Growing-on phase: 15% of the surface (6 weeks in the greenhouse, 8-9 weeks after cell cooling)

Tables or roll containers

Cultivation takes place on tables or roll containers with an open mesh base. *Dendrobium* pot plants cannot be grown on an ebb and flood system or another system with dense soils. This always leads to loss caused by *Fusarium*, *Phytophthora* or *Pythium*. Ensure that there is walking space between the tables or roll containers so maintenance on the crop can be carried out.

- **Heating**
An equivalent under-bench heating and top heating with a capacity of at least 24 °C greenhouse temperature during the growing phase is required.
- **Water storage**
Ensure that there is sufficient water storage, only rainwater or reverse osmosis water is suitable.
- **Reverse flow device**
A reverse flow device or small heated basin in the barn is necessary to raise the temperature of the irrigation water.
- **Screen installation**
You will need screen installation with approximately 50% light permeability. Please note that a screen will age and will block more and more light over time, which can be monitored by a PAR metre. An energy screen at a glasshouse is often necessary to keep the temperature at 24-25 degrees during cultivation, also during the night. Screens are also an excellent way to save energy.
- **Irrigation installation**
An irrigation installation with a dose of fertiliser is necessary with at least two separate mixing tanks for the fertilisers.
- **Assimilation lighting**
During the cultivation phase and in winter, at least 10,000 lux ($120 \mu\text{mol m}^{-2} \text{s}^{-1}$) installed capacity is desired with a day length of 16-18 hours.
- **Roof sprinklers**
Roof sprinklers are not necessary but are useful during hot periods when growth improves at an increased rate of light. Because this tempers the increase of the temperature in the greenhouse, the RH remains more constant in the greenhouse so the plants can continue to assimilate better because the stomata stay open.

Production

The production on a modern site where 84% of the space is used, as can be achieved with roll containers or movable tables, is between the 45–50 plants per m² for a 12 cm pot size. This also depends on the circulation speed, the drop rate and the cooling control. In one growth year, it is feasible to grow 40 to 70% of orchids with double-spikes; the rest will grow with a single spike. A perennial plant can also be grown with multiple spikes in the next season when the single-spiked orchids are being topped. That takes approximately three months longer.

Early varieties flower relatively easily within one year. The late assortment takes a bit more time because their growth rate is slower and their maturing phase longer. The drop rate is an average of 5%.

Spatial planning scheme (cultivating in 12 cm pot size)

Cultivation phase	Plants/net m ²	Period (in weeks)	Area requirements (%)
Potting up to SD	70	18 - 20	approx. 35
Maturing in SD	50	12 - 18	approx. 35
Cooling phase	50	6 - 8	approx. 15
Growing-on into flowering	40	6 - 8	approx. 15

The young plants are delivered in a plug with a spike length of 10–15 cm. The main spike is topped when the plant is potted. At least 3 leaves remain, but better is 4 or 5 on the remainder of the topped cane. In this way, the batch will become uniform and all plants will produce new spikes more or less simultaneously. Then, the plants are potted on in a 12 cm end pot (do not use transparent pots). There is an average of 60 plants per net m² in cultivation and maturing phase over a period of 30 to 36 weeks depending on the assortment and number of multiple spikes.

The plant density is 70 plants per m² at the start and after 12-18 weeks when the plants are spaced for maturing to a hard 'cane', the plant density is an average of 50 plants per m². The plants are staked with support sticks during spacing. Please note: use plasticised sticks against rotting. The plant continues to grow during the maturing phase and will produce its last leaf. Depending on the season, an additional 10-15 centimetres length will be added to the length grown during the cultivation phase. After growing on and maturing of the 'canes' during the short day phase, the plants will enter into cooling for 6 to 8 weeks. Then there are approximately 50 plants per net m². There can be more orchids with single-spikes per m² for example 60, while you should count on 45 double-spikes or 35-40 triple-spikes per m². After the cooling period, the plants will be finished into flowering in approximately 6 to 8 weeks. Then, there are 40 to 45 plants per net m².

Labour intensity

Depending on the mechanisation rate, the labour requirements are approximately 800 to 900 m² per person per year.