Paphiopedilum pot plant

Floricultura ORCHIDACEAE

Production procedures

Substrate

The substrate must consist of free-draining organic mixtures such as bark with 10-20% sphagnum, perlite or coir and 3 kg Dolokal/m^3.

Vegetative phase

- Vegetative phase plantlets delivered in flasks
  Plantlets are delivered in plastic flasks directly from the laboratory. Upon receipt, plants are deflasked into small pots or plugs filled with sphagnum. After 10-12 months, the plants will usually be large enough to transplant into a 10-11 cm pot. Deflasking is seldom done at production facilities due to the high degree of difficulty associated with this procedure. Even minor mistakes lead to a high loss percentage and because it involves seedlings, 25-50% of the plantlets, depending on the hybrid, will not reach the potting-on stage.

- Vegetative phase plantlets delivered in flasks
  Production starts by transplanting the plants with leaves 12-15 cm in length and delivered in 5.5 cm pots into a 10-11 cm pot. Various organic mixtures with good drainage and air retentive capacities can be used. The basis for such a mixture is usually bark, supplemented with some sphagnum, perlite or coir. Each substrate has its own character with regards to providing water. The plants should immediately receive water and nutrients by means of overhead watering. Hand watering is sometimes necessary and is also a good way to monitor the crop. The plants should be arranged in a square grid pattern. Experience has shown that with fewer plants per m^2, the plant quality is better. That way there are approx. 90-100 plants/net m^2.

Flowering phase

After about 12 months, some hybrids can be producing their first flowers so that between 12 and 18 months after potting, an average of 30 to 50% of the plants requiring a warmer climate will be ready for delivery. After these 12 months, each group of hybrids is transferred (if plants are large enough) to its own section where both night and daytime temperatures are somewhat cooler. This procedure applies to both the green-leafed (cool-climate varieties) and the varieties that produce variegated leaves and multiple flowers (warm-climate varieties).

How soon flowers are produced depends very much on the hybrid. A plant is vegetatively mature when it has 6-8 leaves. The shoots developed in the warmer section can be encouraged to initiate flowers by keeping them at lower temperatures. Then there will be approx. 60 plants per net m^2 for about 12 months. During this period, about 80-85% will provide flowering plants ready for delivery.

Remark: Plants that have not flowered after some 24 months should be discarded. In many cases the substrate quality deteriorates rapidly and the plants may have stopped growing. In spite of the fact that the plants may look attractive, there is little guarantee that they will flower soon.

Space utilisation

Transplanted 10-11 cm pot

	Plants/net m^2	Period	Space requirement in %
Transplanted ready to flower	100	18 months	50
Spacing out	60	12 months	50

Temperature

As a rule, the target temperatures depend on the two phases, vegetative and flowering, which also vary according to group.

	Night*)	Day*)
Vegetative phase:		
green-leaved varieties	18-20°C	22-25°C
variegated leaves, multiple flowers	20-22°C	24-26°C
Flowering phase:		
green-leaved varieties**)	15-16°C	18-20°C
variegated leaves, multiple flowers	18-20°C	22-24°C

*) during periods of little light (winter), maintain the lowest indicated temperature and reduce the amount of irrigation water.
**) 5-6 weeks before the desired flowering time, green-leafed varieties can be subjected for 6-9 weeks to temperatures of 12-15°C required for flower initiation.

Light

Paphiopedilum cultivation does not require high light intensities. The best growth and flowering results are obtained by exposing the crop to moderate light intensities from 10,000 to 15,000 lux. High light intensities usually mean higher temperatures and, consequently, a lower RH. This is an essential point that should not be ignored. Paphiopedilum grows best from August to late into October when the natural RH is high.

Shading and whitewashing are required from spring to late autumn to prevent high temperatures. Certain kinds of shading compounds keep excess heat from penetrating the greenhouse whilst admitting more light. Cool wet summers are ideal for Paphiopedilum production but dry hot summers can be a problem. Growth lighting is not necessary but will stimulate increased growth during the winter.

Light intensities	
plantlets	5,000 - 6,000 lux
green-leaved varieties	10,000 - 12,000 lux
variegated-leaved varieties	8,000 - 10,000 lux

Water

Water is one of the most important factors in Paphiopedilum production. Only rainwater or reverse osmosis water is suitable. Any other kind of water will inevitably result in cultivation problems. Salt concentrations must be kept below 250 mg/l and hardness must be below 6°dH. Provide enough water storage capacity. When using a small tank with a reverse osmosis system, a minimum water requirement of 15 litres/m^2/week should be assumed. Particularly in winter, the water must be warm enough. The minimum temperature for irrigation water is 15°C. Cooler irrigation water lowers the pot temperature, and this can result in slowed growth. A heated indoor intermediate tank or a counter-flow system is required.
For the following elements the maximum concentration in the water is as follows. Cl 50 mg/litre, Fe 2 mg/litre and bicarbonate 3°dH hardness.

RH

Providing the proper humidity level ranging from 65 to 80% is important for good growth and flowering. Maintaining the recommended levels 24 hours a day is not necessary. Whitewashing and shading are necessary. Air humidification or the use of roof sprayers will greatly improve the greenhouse climate. When considering cost-effectiveness, roof sprayers are a better investment. The biggest problems usually occur when humidity drops too suddenly. Higher values than 80% are acceptable without any problems, yet in that case it is necessary to ensure sufficient moisture discharge by moderate heating and simultaneous ventilation (air movement in the greenhouse).
Remark: A low RH on sunny days and in spring inhibits growth. When these plants are observed closely, it can be noted that the leaves roll up and take on a drab colour.

Fertilisation

Fertilising and irrigating are done simultaneously. The composition of fertilisers depends on the season and the growth stage of the plants. Although either simple and/or compound fertilisers can be applied, working with compound fertilisers is usually much more practical.
For the vegetative phase, a combination of calcium nitrate, Plantprod or Peters 20-20-20 and magnesium sulphate in a ratio of 3:6:1 would be a fine combination that could be supplied by a 2-tank system. The best EC values are 0.5-0.8 EC. During freezing weather, reducing the EC somewhat would be advisable due to the effect of heating.
Remark: If the foliage becomes too lush, part of the 20-20-20 can temporarily be replaced by 7-11-27 in for instance a ratio of 1:2 or 1:1 or 2:1.
Paphiopedilum is sensitive to salt. Leaching with plain water previous to the winter months is recommended. Also recommended is leaching with plain water alternating with fertiliser having an EC of 0.5 immediately after transplanting to pots.
The pH level should also be monitored because it may become too low. A pH below 5 may lead to calcium deficit. which causes brown leaf tips. The solution is to apply a fertiliser containing calcium without ammonia and/or urea. You do have to add Dolokal to the substrate in advance. Depending on the materials used, Dolokal should be applied at the rate of 3 kg/m^3.

Vegetative phase	winter:	0.5 EC	20-20-20 + calcium nitrate + magnesium sulphate 6:3:1
	summer:	0.8 EC	ditto
Spike inititation to flowering	winter:	0.5 EC	20-20-20/7-11-27 + calcium nitrate + magnesium sulphate
	summer:	0.8 EC	20-20-20 + calcium nitrate + magnesium sulphate

Diseases and pests

With sound cultivation and sufficient control of the most significant insect predators, use of chemical control agents will be the exception rather than rule.

- Brown rot in leaves.
  Brown rot in leaves occurs at high RH and temperatures when plants are largely inactive and with bad hygiene. Calcium deficit may be a cause.
- Shoot rot at base and centre of plant.
  Usually occurs after transplanting and as a result of slowed growth and excessively high plant density. Spray with fungicide.
- Root rot.
  Root rot may be caused by a poorly draining substrate and/or too high EC. Too-cold water may also result in root problems.
- Mites.
  Red spider mites discolour the undersides of leaves. Galumna mites or flat mites (Brevipalpus) can also cause deformed stems and flowers. Spray with an Acaricide.
- Thrips.
  Thrips cause deformation in leaves and flowers. Spray or treat greenhouse atmosphere with insecticide.

It would be best to consult an expert with regard to which chemical control agents to use and what the application dosages are and we recommend to carefully read the labels.

Greenhouse systems

A nursery needs at least two (and preferably 3) sections to produce Paphiopedilum as pot plants:

- Vegetative phase.
  (1) varieties with variegated leaves/multiple flowers requiring a warm climate (vegetative phase of green-leaved varieties can take place in the section accommodating varieties requiring warm temperatures during their flowering phase)
- Flowering phase.
  (2) green-leaved varieties (3) varieties requiring a warmer greenhouse climate with variegated leaves/multiple flowers

Benches/mobile containers

Production takes place on benches or mobile containers with an open bottom. Various materials are possible. Paphiopedilum pot plants cannot be grown on ebb-and-flow systems or other closed benches. That will always cause losses due to Phytophthora and Pythium.

Heating

The heating system used in the cooler section has to maintain a minimum temperature of 18°C at night and 16°C during the day, regardless of outdoor temperatures. The warm section has to achieve a temperature of 23-25°C during the day and 20°C at night.

Water storage

Provide enough water storage capacity. Only rainwater or reverse osmosis water is suitable. A sprinkler system with fertiliser metering is required.

Counterflow system

A counterflow system or small heated indoor intermediate tank is required.

Shading system

A shading installation is required not so much for saving energy but more to limit excess light. A double screen is not necessary. However, whitewashing the roof is.
Remark: An external shading system offers a good way to cultivate at a cooler temperature without whitewashing.

CO_2 system

We consider a CO_2 system an effective addition for optimum growth. Although no studies have been conducted in Paphiopedilum, the crop will undoubtedly benefit from this.

Production

Yields in a modern facility using 84% of its space (as realised by mobile containers or mobile benches) and following proper cultivation methods will be 30-35 plants/m^2/year. The variation will also depend on rate of growth, variety, and loss percentage. Using fixed benches results in a reduction of about 20%. The labour requirement is around 1,500 m^2/worker/year.