Newsletter
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Floricultura®
The orchid professionals since 1933

Plugs!

We have now switched to using plugs for all our young Phalaenopsis plants. We no longer use transplant trays, except for a small number of plants intended for export as unpotted plants or for 6/7-cm pots.

Plugs offer several advantages:

- More uniform plants that don't require any sorting during cultivation and also no, or much less sorting when the plants are ready for delivery.
- More compact plants, minimising differences between individual plants during cultivation. Plants from transplant trays tend to vary in size, resulting in differences between plants depending on whether or not the pots are covered with leaves.
- Customers are able to speed up the finishing process
- Savings in labour during potting, cultivation and the flowering/ delivery phase.
- A higher production per m^2 without increasing the plant density due to the absence of smaller plants needing a longer cultivation period, and hence more room.

Two things are of essential importance in this respect:

- Informing customers about the best way of cultivating plants propagated in plugs, with the customers themselves also learning from their experiences.
- Finding out what aspects can still be improved ourselves.

We try to share all our knowledge and information with our customers to help them optimise and get the most out of their cultivation efforts. However, we are well aware that different customers use different cultivation methods, and that no two nurseries are the same. Even customers with more than one nursery will find that the results of their individual nurseries will never be exactly the same. That's one of the reasons why almost all growers like to use their own specific types of pots and substrate mixtures.

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Practical experience has meanwhile shown that it is quite possible to use different plug systems side by side.
But different growers have different views on such matters as substrates, (e.g. how wet or compact they should be) and pots (how many holes they should contain) and may make changes in their cultivation method without fully realising what consequences those changes may have, especially in their plants' initial development stage. Another aspect is that some of the mixtures supplied by substrate suppliers contain bark, and it may be more difficult to wet those mixtures properly when starting a new crop. Growers will then decide what to do themselves, or they'll follow the provided advice to give their plants small doses of water every other day. But such an irrigation strategy may actually be quite risky and lead to losses. It may work sometimes, if you stick to it for only a few weeks when starting your new crop and then wait for several days between each irrigation session. But it's better to make sure you wet your substrate properly before potting your plants. Small doses of water may have a positive effect in extremely dry weather with a northeasterly wind in April-May, but it's questionable whether that is advisable even if your plugs retain moisture well. What's important is to make sure that the moisture content of your substrate is more or less the same as that of the plug at the time of potting, so don't plant a wet plug in a dry substrate or vice versa. We now know that it's best for plug plants to be kept a bit drier than the former tray plants for the first six to eight weeks after potting, and to then gradually switch to a "normal" irrigation frequency once the roots are clearly visible on the outside of the pot. We have noted that the plants of growers who favour such drier conditions get off to a better start than those of growers who irrigate their young plants more often. Sometimes it's simple things that make all the difference where orchids are concerned. This change in cultivation method may cause some varieties to disappear from the favored cultivar selection. We've seen something similar happen in the past: when cooling capacities were increased some varieties that had done very well until then, suddenly started to show more problems in cooling. And certain varieties were likewise found to respond negatively when the light values used in cultivation were raised.

Phal. '3985'®

Phalaenopsis in winter

Leaf scorch

You may have seen the colour of leaves of your Phalaenopsis change, resulting in the formation of lesions reminiscent of leaf scorch caused by too great a light intensity. However, it's not the light intensity itself that causes the scorching, but a change in the lighting and/or the light spectrum. We have observed scorching in our hot propagation section caused merely by a change in the lighting time. For example, full light after a day without light may cause scorching. Plants that have just been set further apart or moved to a different part of a greenhouse are especially susceptible to changes in lighting. A failure in a total energy system around the transition from the night to the morning causing the lamps to be switched on hours later than usual can also cause problems. The advice is then to start with half the light intensity and not be too desperate to realise the desired light sum that day. You can then switch on the lamps at full intensity at the usual time the next day. Or, say, you have to repair your screens in the morning, and your screens consequently remain closed for hours instead of being opened first thing in the morning. You may then also end up with damage caused by the interference in the plants' day and night rhythm. Their stomata will then probably still be open (CO_2 absorption in the darkness) at the time when they are exposed to full light. The plants won't be able to deal with that and will respond with a kind of scorching of their leaves. Plants are very susceptible to major differences in light intensity between propagation and cooling areas. Try to minimise such differences to avoid damage, either by increasing the light intensity in the last weeks before the cooling, or by setting the plants at the cooling distance in the propagation area (so that they will receive more light), or by reducing the light intensity in the first week of the cooling. A transition from 4 mol/m^2/day to 6 mol/m^2/day is better than one from 3 mol to 7 mol. Theoretically, it would be a good idea to switch on your assimilation lighting a few minutes earlier every day. This can be more practically realised with a quarter of an hour a week. Or switch on your lamps, say, ten or twelve hours after sunset. You will then always have a night of at least ten or twelve hours. Nighttime is very important for Phalaenopsis, to enable the plants to recover from the previous day and prepare for the next one.

Phal. '353911'®

Use of lamps

The efficiency of your lighting is partly dependent on the number of hours of light per 24 hours. Because of its CAM mechanism, a Phalaenopsis needs a sufficiently long periodof darkness. The day length should not exceed fourteen hours. So there's no sense in switching on your lamps any earlier than 4 a.m. in winter if it gets dark at 5 p.m. Switching on your lighting earlier for the purpose of ensuring the desired total of daytime light at a decreasing sum of PAR light is not the solution. There's even less sense in leaving your lamps on for longer in the late afternoon. Sensor measurements have shown that the plants' stomata open and start to absorb CO_2 halfway through the afternoon, as the light starts to decrease. If you leave your lamps on for longer you will disturb this process. Plants need a few hours to get going after a period of darkness. So get a stronger lighting system with a capacity of more than 5,000 lux to switch to its full capacity in increments.

Lush foliage

When the light intensity decreases in winter and you vent your greenhouse less, your plants will start to form longer, more flaccid leaves. This is strongly influenced by the total nitrogen content of your fertiliser applications. Plants are often given extra nitrogen to get them off to a quick start in propagation, for example by replacing 20-20-20 or part of it by 28-14-14 or something similar. This is something that should not be done

for too long in autumn and winter, when you should return to normal ratios after four to six weeks. A combination of 20-20-20 and 20% to 25% calcium nitrate will likely prevent your crop becoming limp, too lush and susceptible to bacteria. A higher leaf temperature and more red light from the SON-T lamps will also lead to more elongation. Other aspects that are important for obtaining attractively shaped plants are the light intensity and the time at which you set your plants further apart. If the latter is done at the right time, your plants will receive more light at lower (artificial) light intensities. All this will help to keep your plants compact even in winter. Growers who use collars, and especially those who use vases will have to be extra alert to make sure that their plants receive sufficient light. If you use vases in propagation, cooling and the final cultivation phase, your plants will need at least 25% more light to ensure the same assimilation effect. So if your aim is for your plants to receive, say, 7 mol light per day during cooling, your light intensity will actually have to be around 8.5-9 mol to achieve the same results as with plants without a collar or vase, otherwise you will end up with a much poorer quality product as a result of the different position of the leaves (which are not horizontal, but slanting or even vertical) and the shading effect of the plastic.

Water

Plants may also use water very differently in winter. At a lower light intensity they use less water, but your extra heating will cause more evaporation! As around 75% of the water evaporates from the pots, they may dry out very quickly. You may then be tempted to give your plants more, but smaller doses of water, but that will involve the risk of reduced or insufficient drainage. How much water you should give your plants will depend on other factors, too, such as the coarseness of your substrate, the type of nozzles you are using and the duration and frequency of your irrigation. You will have to ensure 30 to 40% drainage to prevent the risk of the EC increasing, and to ensure the supply of sufficient fresh air (oxygen) to the substrate. It is important to measure your drainage water for the purpose of monitoring, and where necessary adjusting the volume, EC and pH of your irrigation doses. Weighing your drainage water will tell you whether it's time to irrigate your crop again or whether the drying is taking too long, and you should therefore heat and vent your greenhouse more actively. Your pots should take four to five days to dry. If efficient drying enables you to water your plants more often they will grow more and produce stronger spikes.

Phal. '333869'®

On days with a cutting easterly wind and frost you may regularly switch on your misting system, but do make sure you give your plants sufficient water. Large amounts of moisture will then be extracted from the air and your substrate will dry to the same extent as on a sunny day in mid-April. You are then advised to control your climate on the basis of moisture deficit rather than relative humidity.

EC

The risk of the EC becoming too high is greatest at the top of the pot. Sometimes a rise in EC will go unnoticed if the results of the analyses of the drainage water, EC and substrate appear to be in a normal range because they represent the average of the whole pot. If the top of the roots turn blackish brown and dry out and you see stagnating dark root tips in the pot it is likely that the EC is too high. In some cases the pH will be too low, too. You must then rinse your plants with clean water, using at least fourteen to fifteen litres per m^2. Your aim must be to ensure an EC of 0.8 to 1.0 in the substrate. The EC of the drainage water must be no more than 0.3 EC above the fertiliser value, so it may be between 1 and 1.3.

Heating

Make sure the pipes above your plants are providing enough heat to balance your underbench heating. Preferably stick to the same temperature above and below your crop. First of all heat the underbench pipes to a maximum of 50°C.

Phal. '233912'®

The heating above the crop can then be increased to meet the heat requirement or, say, high relative humidity. Check whether all your pipes are working properly. Pipes may become blocked with accumulated dirt or air may be trapped in your system.

Climate

Heavy snowfall or hail can cause substantial and sudden drops in temperature. If this should happen at a time of unstable weather it's best to keep the temperature in your greenhouse at a constant level by closing your screens and switching on your lamps. Beware of misting too much in moderate weather. start a bit later and use a shorter pulse length. In the case of snow and/or severe frost, misting may slow down the drying of your pots a little. Skip any pre-nights in your cooling. Some varieties find it hard to cope with extra-low temperatures. The desired 24-hour average temperatures will usually be realised in winter. Do bear in mind that in winter (with your lamps switched off and limited insolation), your plant or leaf temperatures will often be lower than in the same 24-hour conditions at a different time of the year. So you must aim to ensure a higher greenhouse temperature. Also bear in mind that the temperature of the foliage may drop a good deal more on cold, clear nights (full moon) than on cloudy nights. Try to compensate for this with your screens and heating. If your greenhouse temperature drops below the heating temperature, LS10 must be closed. The heating will cause it to open again.

Winter checklist

- Carefully check your greenhouse roofs and walls for any broken panes. This is your first potential saving in energy.
- Check your lamps to avoid differences in temperature in the greenhouse and the foliage.
- Check whether your air vents and screens can be closed properly, and if they are not completely closed, whether the gap is the same everywhere in your greenhouse, or else there will be a high risk of a drop in temperature and premature spike formation!
- Clean the inside of your greenhouse roof on a dark, not too cold day, when you will be able to open your screens without too many problems.
- Make sure that your boiler and total energy system are regularly serviced. In winter, your air vents and screens will be closed more often, and the concentration of gases such as CO, NOx and ethylene may then become quite high. Good maintenance of your total energy system will moreover ensure savings in energy. If you find a lot of buds are dropping from your plants, have the air in your greenhouse analysed to check for the release of ethylene.

Cymbidium cultivation tips

Introduction

Insofar as we can estimate at the time of writing this newsletter, the production of the early and Christmas ranges seems to be a bit disappointing. In practice we see varieties and batches with fewer spikes than you'd expect. And when we take a closer look at the plants we see young shoots that are not supposed to be there. Or at least not of this size at this moment. We have also observed differences within one and the same variety, between plants with many spikes and plants with only a few spikes. And it's those with the few spikes that have a lot of shoots. We see the same in our parent plants: plants with plenty of spikes and plants characterised by disappointing production. That would not be surprising in the case of seedlings from the same hybrid, but some of our older parent plants of which we have several specimens show the same differences. This must be due to the conditions in spring, which were dominated by a dry northeasterly wind for a long time. That caused the temperatures to remain fairly low, but the plants in the greenhouses, and also those outdoors, dried out much more, so some plants may have suffered more water shortages than others. And if that happens in the phase of spike elongation, spike buds may dry out. Plants (or bulbs) then skip their flowering and continue with the next phase, the production of shoots. In some years this happens after a sudden week of summer-like conditions around the end of April/beginning of May, but this year it was difficult to pinpoint any specific period that may have caused it. A relatively large number of young shoots were formed in the period from the end of May until mid-June. We also noticed that some of the clones from our parent plants were from time to time drier than we'd assumed. Most of you will no doubt have observed the same thing. Some of you may have discovered it a bit earlier, and will have been able to restrict the negative consequences.

Early range

The varieties that flower in September-October must enter dormancy in November. Those that flower earlier must also enter dormancy earlier. Important is for the 24-hour average temperature to go to 12.5-13°C for a period of at least 90 days; 100 is better. You must then allow a month, possibly six weeks, for activities like spacing the plants further apart and cleaning, before raising the temperature. Christmas is the deadline for varieties that are intended to flower before 1 November, to ensure good flowering in September-October of the next season. The 24-hour average temperature is 13°C, so 13-14°C during the day and 11-12°C at night. You don't have to reduce the temperature any further. If the weather is extremely cold for a short period of, say, two weeks, you can drop the temperature a few degrees. Trials carried out by Wageningen University at Bleiswijk have shown that a 24-hour average of 7°C is possible, but there are varieties for which this is too low, as the Earlisue 'Paddy' and Beauty Fred '60' used in the trials clearly showed. Varieties obtained from Earlisue 'Paddy' or Beauty Fred '60' will probably show a similar reaction.
We believe that low temperatures for a short time during extremely cold weather can help save energy and other costs without having major negative consequences. But once again, this holds only for a short period of one to two weeks at extremely low temperatures. And make sure your climate is always buoyant enough, no matter how low your temperatures are. Your plants must continue to transpire and absorb water. Your plants' water absorption will tell you whether they are still active.

In "warmer" weather conditions, such as an outdoor temperature of 12°C or higher, make sure your plants are to some extent activated in time by venting and switching on a minimum heating pipe for one to two hours in the morning, but do beware of it becoming too hot. Some growers have restricted the maximum temperature of their heating pipes to, say, 40°C with the aid of their computer, in some cases coupled to RH control. But that may involve the risk of the

Cym. 'Diona'

Cym. 'Lightning'

24-hour average temperature becoming too high in a very mild winter. The plants are then not cooled enough, which eventually results in less, later and an extended production time. So it is then important to adjust your settings. Your plants must be cooled for around 90-100 days. The trials that were carried out between 2001 and 2003 showed that a too short period of cooling adversely affects production. In this phase you must give your plants clean water or water of at most 0.25 EC. If you're using fertilisers, don't forget to check your drainage water! The 24-hour average temperature must be raised to 20°C between the end of January and mid-February. You can also do this one to two weeks later to save on heating costs, or if that is more favourable with respect to your heating strategy or desired flowering time. But if you do do it later, you will have to pay extra attention to ensuring the desired total temperature sum. If you should find yourself "in arrears" because of too low temperatures, gradually raise your 24-hour average temperature to just above 20°C, say 20.5°C or 21°C, over a long period, of two to three months. Don't try heating to higher temperatures for a short period or else you'll find yourself losing eyes that were supposed to form spikes. Once again: it's better to stick to 20.5°C for three months than 23°C for three weeks! Some growers start earlier in January, but that may be disadvantageous for some species because on dark days, the higher 24-hour average temperature will cause the plants to consume more energy (sugars) than they produce. Flower buds will then stall, and later in the season shoots will appear in places where the plant should have had spikes. After mid-February there will be sufficient light and the light intensity will increase day by day, eliminating this problem.

Unless you have double glazing, it's a good idea to use a plastic air-conditioner screen to ensure a good plant temperature from January until mid-March. This will also help you save a lot of energy. Vent at intervals when the temperature rises on sunny days, as is often the case in March. Close the air vents in time in the afternoon to keep the warm air inside in order to save energy. This will also minimise drops in leaf/plant temperature. Some growers may find that their heating has not had the desired effect of earlier production. In such cases you must consider the 24-hour average temperatures realised in the different parts of the season. At temperatures above 21°C the elongation of the spikes will stop. Spikes that are shorter than around 10 cm won't grow if the temperature rises too much. Spikes longer than 10 cm will elongate faster at higher temperatures. Elongation will slow down on wet, dark days in autumn, especially if your greenhouse is still whitewashed, simply because the plant temperature is too low.

Christmas range

What has been outlined above holds for the Christmas range too, only 1.5 months later. Make sure that these plants are in their intended positions before Saint Valentine's Day. If you wait any longer, you may encounter problems if March starts with good weather. If you set your plants further apart at the right time they will be acclimatised by the time that the daytime temperatures start to rise and the RH starts to decrease. When that happens there's a risk of your spike buds drying out.
The first fourteen days after Cymbidium plants have been moved they absorb 50% less water than usual. From early April onwards you may adhere to a 24-hour average temperature of 20°C for these plants, too. You will often be able to realise this via the natural conditions, but you may have to use climate control if the weather is cold and miserable for a long time. Do keep a close eye on your water consumption. Some cultivars that flower around Christmas time absorb a lot of water during the spike-elongation phase. If you tend to favour dry conditions, you will have to give your plants some extra water in sunny weather or else you'll lose buds. If on the contrary, you usually water your plants regularly, you may have to skip an irrigation session if the weather remains mild and wet for some time, or else some varieties may stop forming roots. Measure your water doses and drainage water every week, checking the EC of the drainage water of the various varieties. This may prevent a lot of problems as it will tell you in time which are absorbing more water than others. A rise in the EC of the drainage water will also tell you that your plants are making less or no use of the supplied nutrients. You must then lower the EC to maintain the quality of the roots. Make sure that the temperature of the water is at least 12°C.

Mid-range varieties

To ensure flowering for the next year, the mid-range varieties must be cooled during the final cultivation/spike-elongation and flowering phases, from November onwards. This will usually be adequate, especially for varieties that are intended to flower up to and including Women's Day (1st week of March). If you use more heating to get your plants to flower in time for Easter you may end up with insufficient time to cool these varieties adequately. And this may cause them to flower later in the next season. In 2016 Easter will be very early, on 27/28 March! This means that you've got to decide now whether you want to raise your temperatures a bit to get your plants to flower earlier, or whether you want to ensure an active/cold climate from early November onwards to slow down production. And by "active" climate we mean low temperatures with due allowance for the relative humidity and outside temperatures.

Late range

The late range will still be being kept at a 24-hour average temperature of at least 20-21°C. The varieties that are intended to flower really late (June-July) must be kept warm (to delay their flowering) until Christmas. Some growers will continue to heat their plants until early-mid-January. Growers who are able to ensure a good climate for flowering in June, too, will succeed in achieving a good spike quality at high temperatures. A prerequisite for this is a higher greenhouse with a misting system and/or an outdoor screen, otherwise there will be too much risk of a warm spring causing the plants to flower sooner, with smaller flowers of less intense colours. The transition to cold conditions must be effected step by step, over a period of ten to fourteen days. The temperatures may then be very low - 8-10°C – but this will also depend on the outdoor conditions and the relative humidity. If it's freezing outside, you may drop below 10°C transpiration will then still be more than adequate. But if the weather is far too warm for the time of year you will have to vent regularly and switch on your lowest heating pipe for 1-1.5 hours every day to keep your crop active. The plants of the late varieties will be able to take up plenty of nutrients until at least mid-January. You may well be giving your plants 0.7 EC and measuring only 0.4 EC in the drainage water. However, within one week this may stop, and the plants may then take up no more nutrients. You will then see the EC of the drainage water increase. You must then immediately halve the EC! Continue to measure the EC and pH of the drainage water of the different hybridss every week, and make sure that your plants transpire on average around 2-3 litres/m^2/week, i.e. almost as much as on an average summer day!

Control

You must check your plants for red spider mites in winter, too. In the areas containing your late varieties the heating will remain on for a long time. All greenhouses have areas that are more susceptible to infestations of red spider mites. Heated areas in particular will contain drier areas that are attractive for mites, and if those areas happen to contain susceptible species you may expect infestations. Such (minor) infestations can still be effectively controlled fairly easily. Infestations that remain unobserved until the time when you start to tie up the spikes will be far more difficult to control. The same holds for infestations in the early and mid-flowering ranges. The very early varieties will require attention when you start to raise thetemperatures. Regular scouting will prevent serious problems and enable you to keep your crop almost entirely free of red spider mites with minimal control.

Snow

Snowfall will result in a very dry climate in your greenhouse. This is something that many growers still underestimate every year. A greenhouse then has the same effect as a condenser dryer. It costs ten times more energy to melt ice or snow of 0°C than to increase the temperature of that same amount of water or ice by 1°C. The temperature in the greenhouse may then not feel warm, but the air will be extracting a lot more moisture from the plants and pots than you may think. So then you need to give your plants more water!

Relative humidity

It is now autumn. Generally speaking, two main trends can be distinguished in terms of relative humidity: too low in spring/summer and too high in autumn/winter. After the end of July-mid-August, depending on the weather, you will have to promote an active humidity strategy by venting and heating at the right times. Keeping your greenhouse closed as much as possible in the hope of achieving a good quality with as little gas usage as possible per m^2 is not a sensible option. It will actually adversely affect the quality of your plants. So the line representing ventilation in a graph must coincide or run below the line representing the heating. When it gets so cold that you need to wear a thick coat and gloves you will be automatically heating your greenhouse more, and climate problems will vanish into thin air. In the course of January/early February the RH in your greenhouse may decrease too much, especially during periods of frost and/or a northeasterly wind. Then your aim must be to minimise the loss of moisture by venting less and keeping your screens closed more often.

Cym. 'Jade'

New developments in climate control

Some of you may already have followed the HNT (Het Nieuwe Telen) course focusing on new energy-saving cultivation methods. The past two years the Kas als Energiebron (KaE; 'The Greenhouse as a Source of Energy') programme has invested a lot of money in sharing expertise on the new cultivation methods for the purpose of saving energy. And those investments are now beginning to pay off. Closer study of physical principles in relation to plant processes and climate leads to new views on control and systems. And in many cases the theoretical results prove to work efficiently in practice, too, resulting in greater savings in energy at the same production levels, and sometimes even greater production, too! However, most of the positive results and experiences were obtained in "ordinary" C3 crops. Whether the various theories will also work in the case of, say, CAM or partly CAM plants is not certain. One of the key aims of the new methods is energy-efficient dehumidification. That's achieved by doing things in precisely the opposite order of what most growers are used to doing, i.e. by first venting, then opening the screens and only then raising the temperature of the heating system. Growers tend to start with the heating, then open their screens and finally the air vents. But raising the temperature of your heating system will cause (ordinary) plants to transpire more, resulting in more moisture in your greenhouse! Because Phalaenopsis plants are propagated at high temperatures it is very easy to lower the humidity, even with closed screens. How is that possible? Many screens transmit a certain percentage of moisture. Your screen supplier will be able to tell you what that percentage is in your case. That's also important information for growers if you ever want to replace

any of your screens. So screens that transmit moisture even when they are closed for a long time can save a lot of energy. In fact, such screens can actually save more energy than other energy-saving screens that have to be left partly open to get rid of the moisture!

A measurement unit above your screen will provide a lot of useful information on the conditions there, especially the humidity. The unit will tell you the difference in absolute humidity of the air above and under the screen, and you will then know to what extent you can dehumidify the atmosphere via the air above the screen. It's a good idea to browse the net to find out more about the new modes of ventilation and learn how the release of energy from plants and flowers can be restricted, without altogether blocking it, simply by keeping your screens closed. In some crops guttation can be limited by keeping the screens closed at night. Guttation is sometimes regarded as a positive phenomenon, but we don't like to see it in our pot orchids. Substantial savings in energy can be realised with certain meters and sensors, and your plants will often feel happier too. You will actually end up with a win/win/win situation because plants that are growing well will be less readily affected by pests and diseases. Take for example your PAR meters that help you decide when to switch off your lamps once a certain light sum has been realised. Less well-known are pyrgeometers, which will warn you of high levels of radiation causing plant temperatures to drop. This can then be prevented by closing your screens (earlier). Recent research in Phalaenopsis focused on the less efficient times for using lighting at the beginning and end of the day (this will depend on the intensity of the lighting and the possibility of switching on only a proportion of the lamps). It's well worth finding out more about such meters and the research findings; you may greatly benefit from them.

Milt. '1338'®

Dendrobium Nobile: new research and findings

In 2014 and 2015 research was carried out in different seasons to investigate ways of promoting more efficient use of light and CO_2 in various crops such as Bouvardia, Gerbera, Freesia, Alstroemeria and Dendrobium Nobile. The practical trials and measurements involving the Dendrobium Nobile variety Spring Dream 'Apollon' have meanwhile been completed and the findings have been published in a report. We would like to share some of those findings with you in this newsletter. In practice, the performance of plants, measured in the form of photosynthesis response, proves to be quite a bit lower than the plants' potential. It is assumed that this is largely attributable to the stomata, and that they are often closed, or at least not entirely open. Also an important aspect in this context is the moisture content of the substrate. Many pot orchids tolerate light less on the day before they are watered. Drops in the photosynthesis response were measured on several occasions, especially at the beginning and end of the day. They were found to coincide with VPD (Vapour Pressure Deficit) values higher than 1.0. The VPD indicates the difference in vapour pressure inside and outside the leaf.

The higher the VPD value, the faster the leaves will dry out. As plants don't perform optimally when their stomata are closed (that's rather like trying to breathe through a straw) there's no sense in using assimilation lighting with a capacity of say, 100 PAR (µ mol per sec). It has been experimentally proven that it is not economical to switch lighting to 100 PAR for the purpose of getting plants going after the night. This is because plants are then using only 50-60% of the supplied light, so then half the intensity will often be sufficient (depending on your specific conditions regarding (total) energy and the purchase/sale of energy, etc.). So if you have a 50-60 PAR system, you will be able to switch it on to its full capacity at the beginning of the day. See it this way: plants still need to wake up to values above 50-60 PAR. To return to the VPD, we have noted that a VPD of around 1.0 is very effective in the case of many crops, to promote their growth and keep their stomata open. To monitor the VPD you will need an infrared meter coupled to your climate computer for continuous measurement of the leaf temperature. Another interesting finding is that it takes plants longer to get going and "wake up" in the final cultivation phase. This was found to take up to three hours, whereas the plants needed only about one hour before being able to benefit from 100 PAR in the propagation phase (measured in younger leaves and plants). However, the (theoretically) too high light intensity may promote better bud formation in Nobile in the generative phase, or better spike induction in, say, Phalaenopsis. It will still have to be investigated as to whether it's possible to eliminate the surplus light without negative consequences. What the researchers had hypothesized about on the basis of literature research indeed proved to be the case in practice. Dendrobium Nobile proves to be able to act as a CAM plant up to a point. During the night the plants absorb CO_2 and store it in the form of malate. The stored CO_2 is then used in the leaf for photosynthesis in the daylight, while the stomata may be partly closed. This can be fairly easily tested by analysing leaf samples. The analysis showed that the leaves contained

Den. Comet King 'Akatsuki'®

malate in the morning of a cloudy day, but also still in the afternoon (light causes the malate to decompose). Being an acid, malate causes the pH discolouration of the liquid used in the test. The decomposition rate was found to be much greater on a day with a lot of insolation. The concentration of acid could be seen to decrease during the day, to the point at which it disappeared completely, indicating that it had all been consumed/converted. This mechanism is not observed in many plants. The intention is to include other varieties besides Apollon in the research. The CAM mechanism is ideal for keeping the photosynthesis process going under difficult conditions, for example low RHs and high VPDs. It's the plants' way of protecting themselves. In the case of Dendrobium Nobile the CAM mechanism appears to be most effective in the final cultivation phase, when the plants and leaves are older. Interestingly, the measurements also showed that the stomata closed around 2 p.m., both during propagation and in the final cultivation phase. When this happens the photosynthesis rapidly declines. In this case the lamps were switched on at 3 a.m., implying a decrease in photosynthesis after eleven hours already. It's still too early to decide to switch off the lamps at 2 p.m., because we also need a certain day length to bring about a difference between the plants' growth and their period of rest. It could be interesting to investigate ways of keeping the stomata open for longer, or to get them to open up further, with due allowance for the humidity of the plants' surroundings.
It is known that a high CO_2 concentration can cause stomata to close, so that's something you should try to prevent.
The researchers noted that the stomata began to close at a concentration of 600 ppm, as also observed for Kalanchoe and Phalaenopsis. At 700-800 ppm saturation occurs. Generally speaking, there's no sense in using doses of more than 600-700 ppm. Only in the case of partly closed stomata is it theoretically possible for a concentration of 800 ppm CO_2 to result in greater absorption by the leaves. That's another interesting topic for future research. In the tests so far carried out there appeared to be no differences in CO_2 absorption in the different seasons. That's actually quite surprising, because you'd expect to see differences in growth in the different seasons. Research and tests like these are steadily increasing our understanding of our crops, enabling us to further optimise the conditions in which we grow them.

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