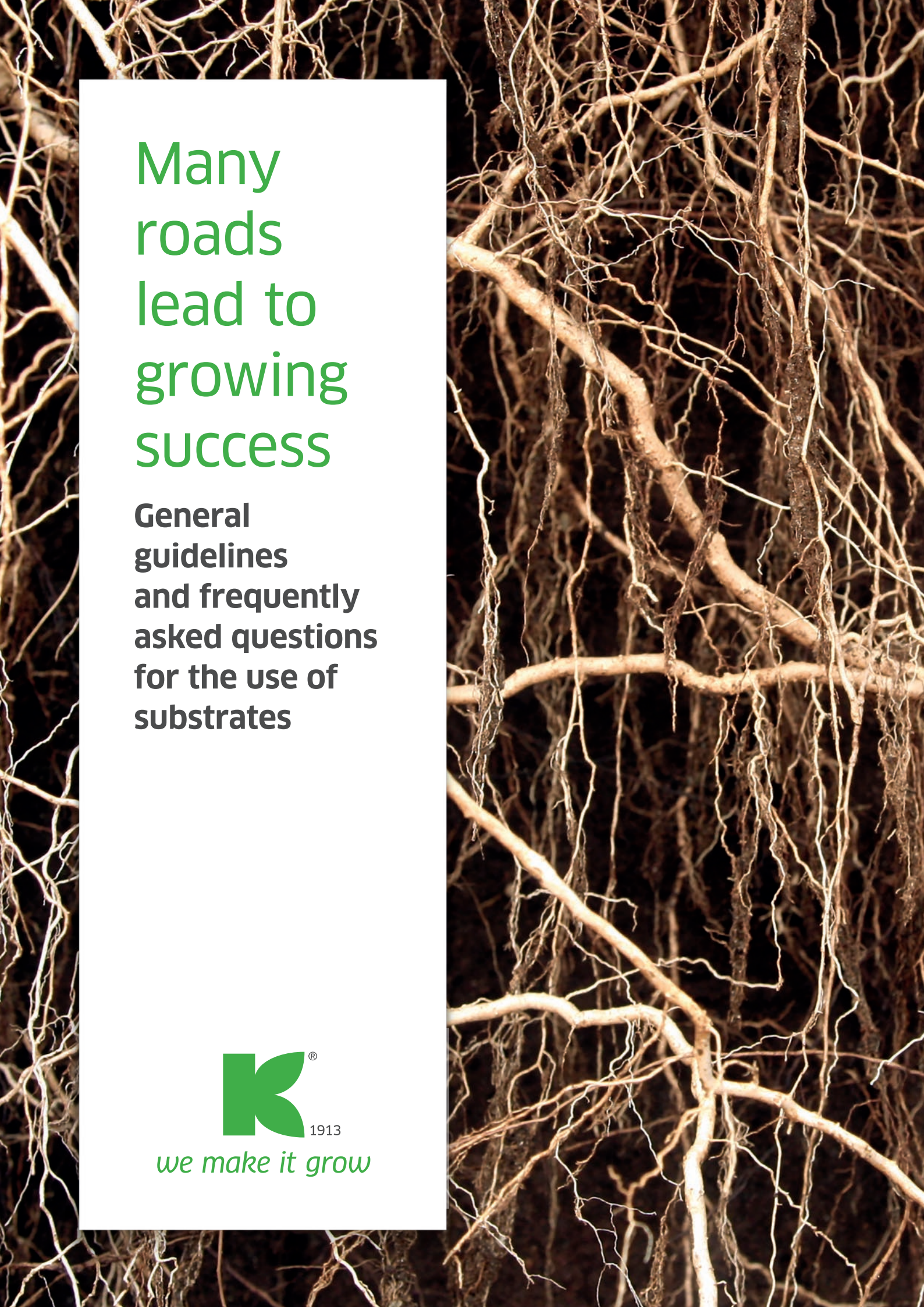


Many roads lead to growing success

General guidelines and frequently asked questions for the use of substrates

1913

we make it grow

GENERAL GUIDELINES 04

FREQUENTLY ASKED QUESTIONS 20

HAPPY END – RIGHT FROM THE BEGINNING

GENERAL GUIDELINES

All beginnings are simple

Substrates from Klasmann-Deilmann are high-quality products developed to ensure optimal plant growth. To achieve the best performance from the product, it is recommended to consider the following guidelines for using the substrates in the nursery.

Loosening up and mixing of compressed substrates

Substrates delivered in compressed bales (either 200 L or Big Bales) require some gentle loosening up prior to use. It is not necessary to mix the substrate any further with additives such as lime or fertiliser as it is already a homogeneous, pH adjusted ready to use mix.

During the process of loosening up, some water should be added to ensure optimal moisture during handling and the best outturn volume from the compressed bales. For transplanting a moisture level of 60 – 65 vol.-% is ideal. This allows best mechanical handling while potting or filling of trays and minimises a transplanting "shock" of young plants. Moreover, it allows the substrate to re-wet easily during first irrigation after transplanting or after seeding.

Therefore, the following should be checked before use:
- Take some substrate into your hand. If you are able to blow it away easily, it is too dry.
- 8 litres of water per 200 l bale is usually sufficient to bring back the moisture to an optimal level.
- Optimal moisture is given when you are not able to press out water by hand, but you can hear squishy sounds when pressing the substrate in your hand close to your ear. The substrate should keep its shape after compressing by hand.

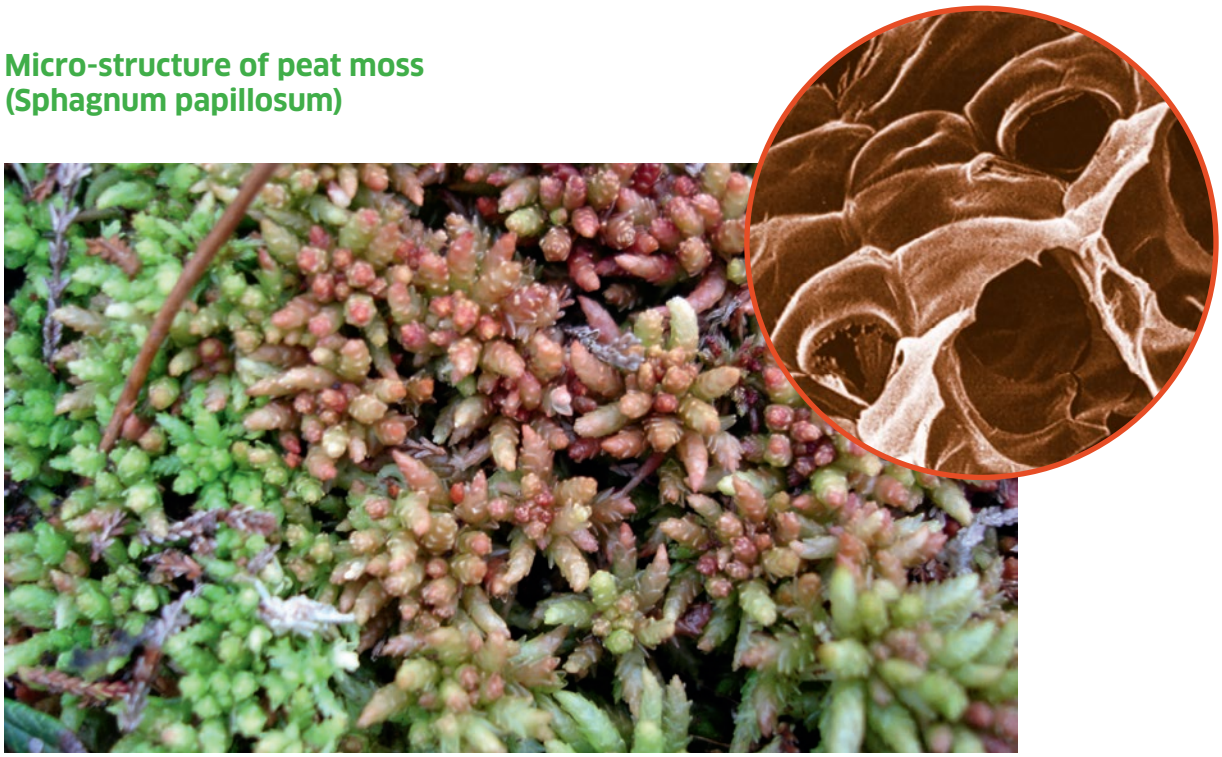
Substrate too dry – looses its shape after pressing

Optimal moisture – substrate keeps its shape

Squishy sound but no water droplets when pressed

The majority of substrates are based on oligotrophic peat as main or sole constituent. The beneficial physical properties of peat moss are due to the cell structure of the sphagnum moss which provides a large volume of pores filled with water and air. In terms of uptake of water and air, this original cell structure is still mechanically active in peat based growing media. Any step in the production process from harvest in the peat field until final use in the nursery, needs to make sure, that this micro-structure of the peat moss remains unaffected. This secures the specific physical benefits of sphagnum peat and ensures best performance of the substrate in the crop.

Micro-structure of peat moss (Sphagnum papillosum)



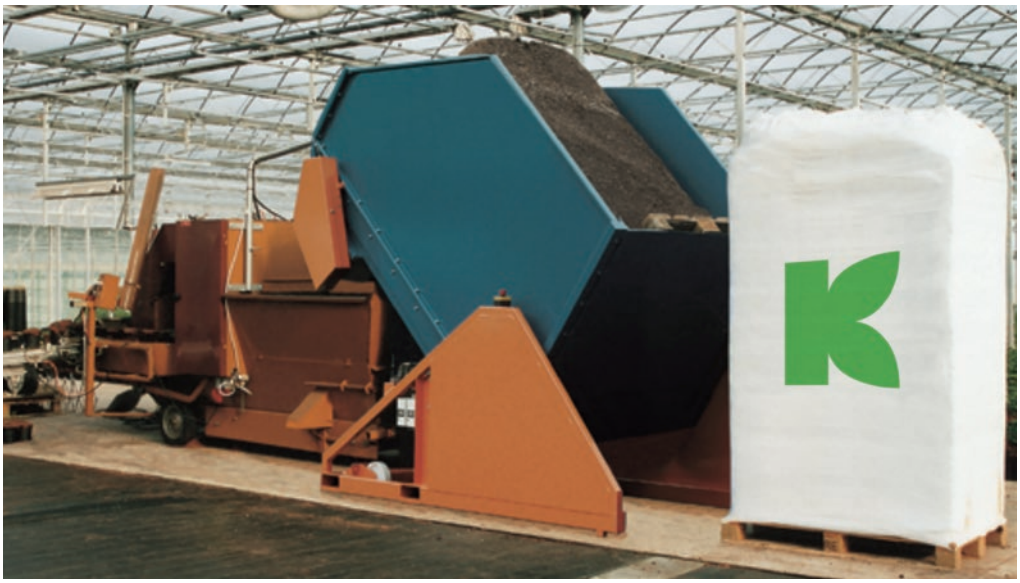
Loosening up always needs to be done carefully in order to preserve the structure of the substrate. This is particularly important for coarser structures based on sod peat fractions where excessive loosening up or mixing will break down the structure and create high amount of fine particles. Aggressive mixing facilities (such as the mill in the picture below) will destroy the structure of the product and therefore its physical properties.

Possibillities to loosen up compressed substrates

By hand:
A shovel can be used to mix the substrate with water while loosening up.

By machine:
Specific substrate mixers or bale breakers are available. The mixing time should be restricted to a minimum in order to maintain the structure of the product.

Products delivered in Big Bales can be loosened up by specific bale breakers, by hand (shovel) or even by wheel loader bucket.



Specific bale breaker machines can be used to obtain sufficient and efficient loosening up of substrates in Big Bales

If required, controlled release fertiliser, organic fertiliser or other specific constituents and additives can be mixed in while loosening up the substrate. If additional additives need to be mixed into the substrate, they should be mixed thoroughly either by using a shovel and turning the substrate 3 times or by using specific substrate mixing machines.

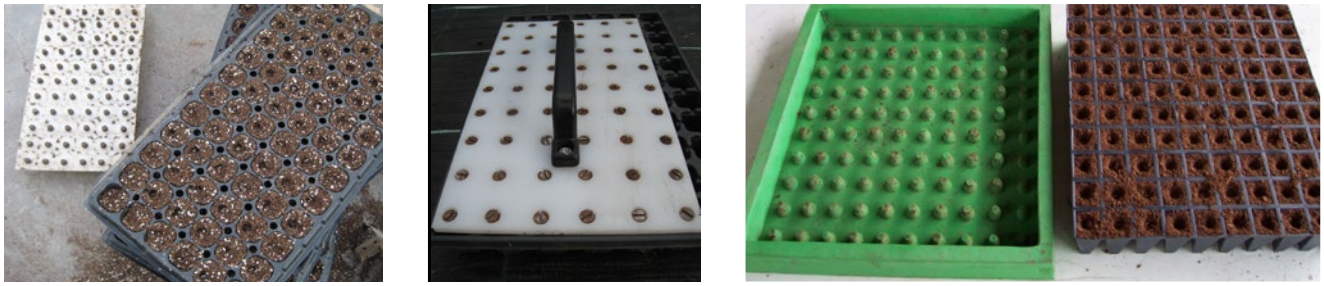
Additionally, controlled release fertiliser can be dibbled directly into the pot at time of transplanting at the potting machines with an automatic dosage system.

Filling of cell trays and sowing

Cell trays should always be filled very evenly with substrate to ensure maximum homogeneity of crop growth. Tray filling can be done manually or by specific tray filler machines and sowing lines. The aim is to have always the same amount of substrate and similar compaction in each cell of a tray. This ensures a similar water capacity in each cell and reduces issues with irregular crop development during cultivation. Below some important steps are listed to be considered when using substrates in cell trays.

Manual filling of trays:

1. Fill substrate into the tray and spread it homogeneously into all cells.
2. Afterwards tap the tray 2 to 3 times on the ground or table to ensure an initial slight compaction of substrate. This shows whether all cells are filled evenly. Cells with too little substrate can be filled up afterwards.
3. Remove overfilled substrate from the tray by scratching the tray off with a board.
4. Use of a simple dibbling board can support the tray filling process. It helps to provide similar compaction in each cell and can create the hole for the seed prill directly.
5. Sowing can take place into the readily dibbled holes.

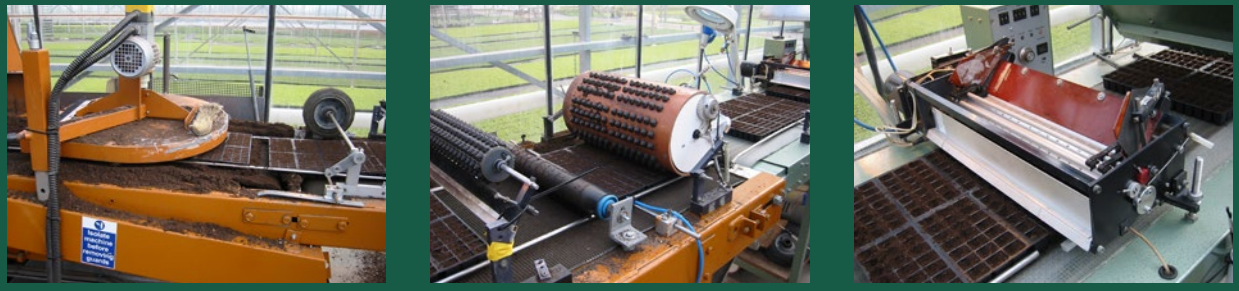


Readily filled trays and examples of different dibbling boards

After sowing:

1. The trays can be covered with perlite, vermiculte or washed sand. The aim is to keep the seed prills safely on the substrate surface to protect them from strong sunlight and drying out. This should be applied prior to final irrigation.
2. Seeds of some plant species require darkness and specific temperatures to induce germination. Thus, the trays need to be covered or moved into a germination room. Examples of some plant species with germination induced by darkness are Cyclamen, Lilium, Helleborus, Nigella, Coriander and many others.
3. Careful irrigation should be given as a final step to ensure a good contact between the seed and the substrate. Make sure the seeds are not washed out of the tray.

Example of an automatic tray filling and seeding line:



Filling of trays

Compaction and dibbling

Automatic sowing

Filling of pots and transplanting

- Pots should be filled to the top with substrate, with a slight overfilling. During transplanting and after initial irrigation, some compaction of the substrate happens what levels the substrate surface down. Otherwise pots become underfilled after the transplanting process.
- Young plants should not be potted too deeply into the substrate as they may sink further into the substrate during the first days after transplanting.
- Deeply potted plants might suffer from air and light deficiency around the stem zone what may lead to limited growth and fungal infections.
- After transplanting, the crop should be irrigated carefully to allow the substrate to reach a final compaction and ensure good contact with the plant roots.

Correct transplanting of rooted young plants into pots

Slight overfilling before potting | First compaction while potting | Second compaction after irrigation | Plant is potted too deep

Irrigation – Important aspects

Consider the water capacity of the substrate

- An important advantage of peat based substrates is the water holding capacity which is significantly higher than with other growing media (e.g. bark, coir, rice husks, etc.). Therefore, the irrigation regime in the nursery needs to be adjusted accordingly in order to achieve optimal product performance when starting to use it for the first time.
- If the irrigation regime for peat based substrates is the same as for other growing media it is very likely that the peat based substrate receives too much water. Subsequently this may have a negative effect on plant growth.
- In general, peat based substrates require less frequent irrigation than substrates based on other constituents. The higher water retention allows extending the intervals between irrigation.
- Extended irrigation intervals allow the substrate surface to dry off what can support a healthier crop with less pressure from fungal infections.
- Less frequent irrigation also means less leaching of nutrients from the substrate. Therefore, it is possible that the need for fertiliser applications in peat based substrates may also be less than with other growing media.

Dark brown or black colour of the substrate surface and visible water indicates a too wet substrate

Root growth is poor under wet conditions. The substrate may loose its structure and fine particles may accumulate at the bottom of the pot leading to waterlogging

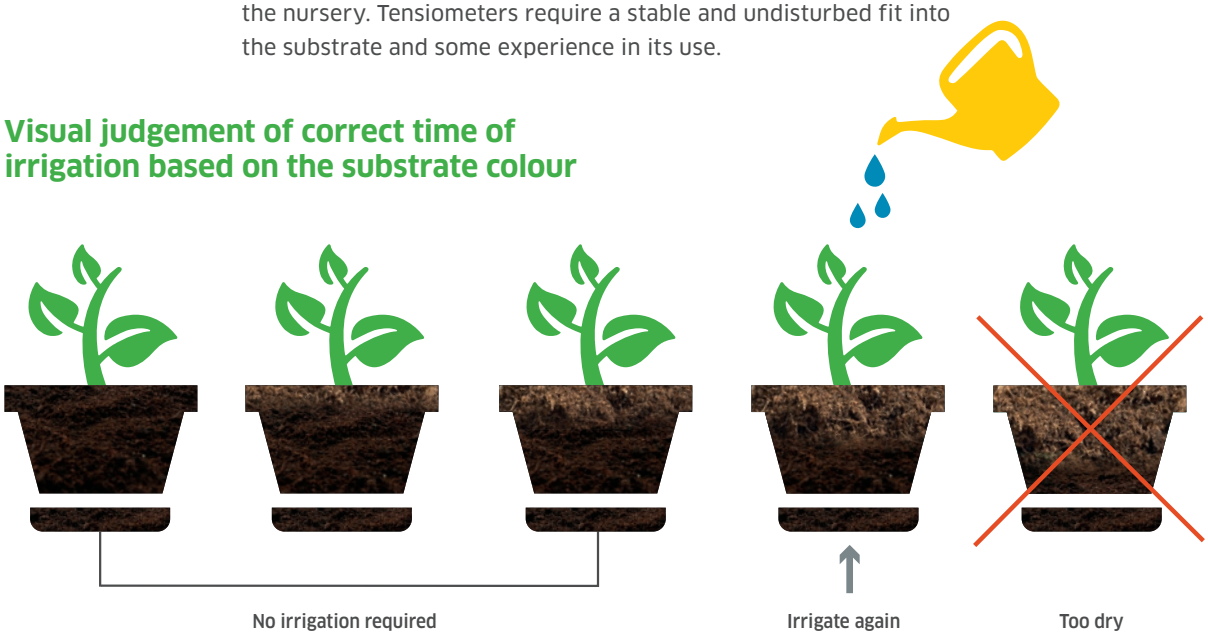
Plants suffer from stress which results in higher pressure from pests and diseases (Pythium, Phytophthora, Fusarium, Sciarid flies, etc.)

Liverwort and algae start to develop on the substrate surface under wet conditions

Controls prior to irrigation:

1. Check the moisture level of the substrate. Is irrigation required? The substrate colour is often an indicator if it turns to light brown.
2. Check the moisture not only at the surface, but also at the bottom of the root ball. Irrgation is only required when the upper half of the root zone is completely dry.
3. Check the weight of pots or trays. Even if the substrate seems to be light and dry on top, the moisture level at the bottom may still be sufficient for optimal plant growth.
4. Moisture sensors such as tensiometers can be used as a tool to monitor or even control automatically the substrate moisture levels during cultivation by magnetic water valves. It is important to consider that these need to be calibrated to the specific substrate used in the nursery. Tensiometers require a stable and undisturbed fit into the substrate and some experience in its use.

Visual judgement of correct time of irrigation based on the substrate colour



Irrigation should be given carefully with moderate water pressure.
The water spray should be fine and the distance to plants not too close.
Ensure that plants at rims and at corners of tables receive sufficient irrigation.

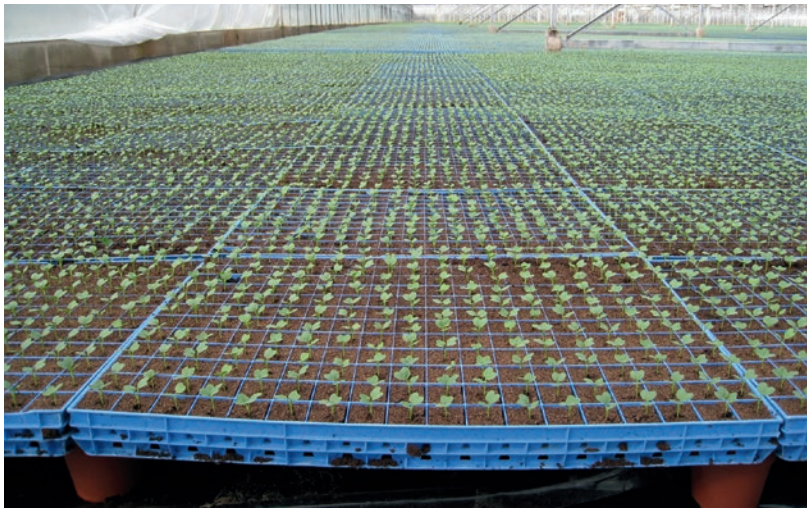
The irrigation process

- Irrigation should be done carefully with moderate water pressure to ensure that substrate, seeds and young plants do not wash away from the pots or trays.
- Irrigation with too high water pressure can lead to compaction of the substrate's top layer and a subsequent development of a hard crust. This may cause issues with re-wetting of the substrate as well as aeration of plant roots and can result in stronger growth of algae on the substrate surface.
- Do not apply excessive amount of water to the crop to avoid waterlogged situations in the root zone as this may increase problems with root diseases such as Pythium, Rhizoctonia and Phytophtora.
- In general, a dry cultivation of the crop with moderate irrigation reduces the risk of algae growth and - even more important – fungal infections of the crop. Allow the substrate surface to dry off for longer periods if possible. Plant growth then is healthier as plant stress from too much water and subsequent pressure from pests and diseases are reduced.
- The initial irrigation of substrates after transplanting or sowing should be carried out very accurately to ensure the whole substrate receives water homogeneously. This avoids inhomogeneous drying off within a tray or between pots during the cultivation process. Homogeneity of irrigation results in homogeneity of the crop.
- In particular the rims of a crop need to be irrigated sufficiently and more carefully, due to the so called 'rim effect'. The rim effect leads to a stronger drying back of pots or trays at the rims or at corners of a plant batch due to air flow and temperature differences.

General rules for irrigation

- Irrigation should be carried out in the morning to allow the substrate surface and plant leaves to dry off during the day. The leaves should turn dry before nighttime, since this reduces pressure for fungal leaf infections e.g. by Botrytis, Ramularia and others.
- Never apply water during strong sunlight around midday as this can cause leaf burnings.
- Some crops are sensitive to cold water (e.g. Saintpaulia ionantha, some succulents) and leaf damage can appear when cold water is applied. Thus, irrigation water should not differ by more than 10 °C compared to the air temperature for such crops. Storage of irrigation water in the greenhouse is recommended.
- During irrigation make sure that the substrate is throroughly moistened. No dry zones should be left in the root zone.
- Watering should only be carried out when the substrate has dried off sufficiently. Visual judgement based on the colour of the substrate, pot weights or maybe moisture monitoring by sensors indicates whether irrigation is necessary again.

Possible measures to ensure drainage and avoid waterlogged situations



Cabbage young plants after germination,
trays positioned on pots to ensure free draining

Anthurium in 13 cm pots placed on pots
turned upside down to ensure free draining

Recommendations for peat substrates storage

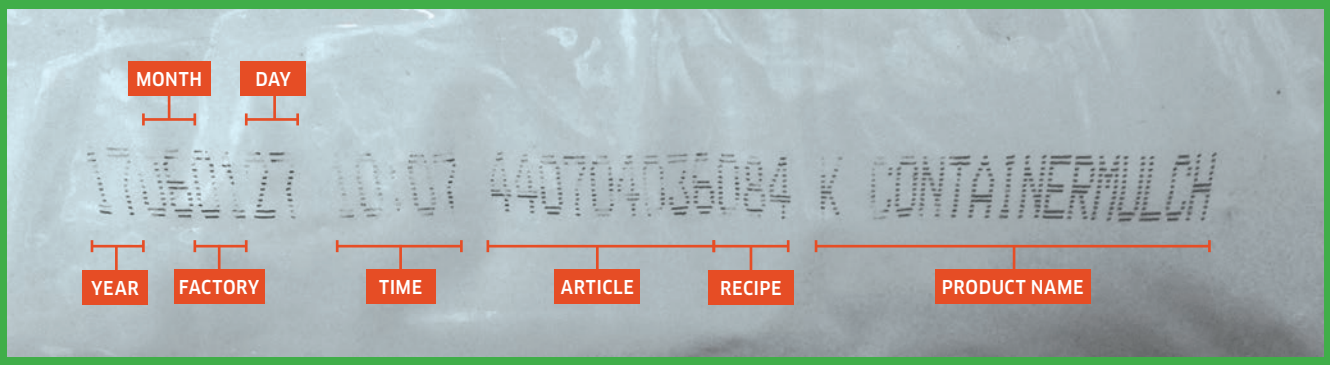
Substrates are products based on natural raw materials with high amount of organic matter and microbial activity. To limit the effect of microbial activity on nutrition and pH and to ensure a 'fresh' and optimal substrate even after some storage time it is recommended to consider the following hints for storage:

- Never stock in direct sunlight.
- If possible, stock inside (no sun, no rain).
- Protect pallets stored outside against sunlight e.g. with netting (UV light stable).
- Stock substrates as cool as possible. Substrates in Big Bales should always be stored below 25 °C.
- Follow strictly "Fi-Fo" = First in, first out! (Check bale codes for production date).
- Propagation substrates should be used as fresh as possible, ideally within a few weeks.
- In general try to stock substrates as short as possible on the nursery and use them as fresh as possible.
- In case of overstocking of substrate a nutrient analysis and ideally a bio assay e.g. with Chinese cabbage and lettuce are recommended before use, as this helps to determine if the product still can be used without problems. Long storage times may lead to increased pH levels and some loss of nitrogen, especially nitrate nitrogen. Therefore additional feed with calcium nitrate is recommened when using overstocked substrates as this brings back sufficient nitrate levels into the substrate in order to avoid a pure ammonium supply. This measure will maintain a successful germination and initial plant development.

Incorrect and unprotected storage outside

Optimal storage of 200L bales in a protected location

Example for the coding on a bale



Recycling of substrates and blending with local raw materials

Sometimes peat or substrates are mixed with local raw materials, in this case the following hints should be considered:

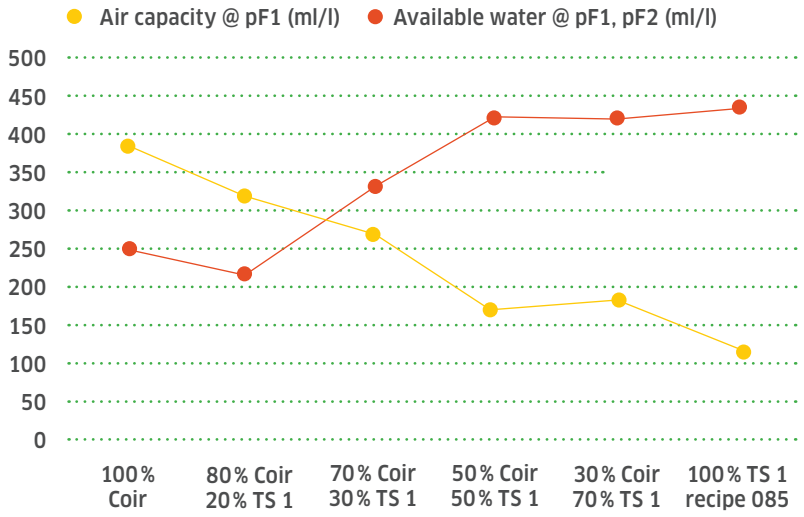
– Use only clean and high quality raw materials when available locally to avoid cross contaminations with pests and diseases or weed in the RHP certified substrates from Klasmann-Deilmann.
– Recycling of substrates may cause high risks for contaminations with plant diseases such as Phytophthora, Botrytis, Pythium, Rhizoctonia and others. Make sure the recycled substrate got sterilised thoroughly (e. g. by heat steaming) before mixing it with fresh RHP certified substrates from Klasmann-Deilmann.
– The recycled substrate will have lost most of its physical structure and show a high amount of fine particles which limit drainage and air capacity. Make sure the fresh unused substrate has a sufficiently coarse structure to ensure a good air capacity and drainage also in the final blend with recycled substrate.
– Alternative areas of application (such as soil improvement, etc.) should be checked for used substrates, as the best plant quality will always be achieved by using fresh RHP certified substrates from Klasmann-Deilmann purely.

Use of coir:

In trials blends of sphagnum peat moss and high-quality coir have been able to complement each other. The combination of peat and coir can improve the following properties in comparison with purely coir based substrates:

– More water available to plants
– More air available to plants
– Improved air/water ratio
– More stable pH value during crop cultivation
– Reduced risks for salt and dilution of unfavourable nutrient contents
– Improved nutrient availability due to an increased nutrient buffer
– Better root development and easier take off of young plants after transplating into the field
– Ideal price/performance ratio

A combination of 30 to 50 vol-% peat moss and quality-controlled washed and buffered coir is able to improve the results of crops significantly.



READ MORE

– Technical Scripture: ‘Peat moss and coir in horticultural substrates’

Application of substrates for organic cultivation

The demand for organically grown plants, especially vegetables and pot herbs, has grown significantly during the recent years, not only in Europe but also globally. Whereas in the past this was a major topic in European countries there is nowadays international demand for specialised substrates for organic growing. However, these special substrates require deep knowledge about suitable ingredients and handling of products. With more than 20 years of experience in the development and production of substrates for organic growing, Klasmann-Deilmann is also the international partner for tailor-made solutions in this field.

- Growers in Europe can choose from a range of proven and tested recipes for organic growing including full nutrition and Ecocert® certification. This is due to shorter transport and storage times.
- Growers of overseas countries e. g. in Africa, Asia-Pacific or America who want to purchase substrates for organic growing from Klasmann-Deilmann face some limitations in terms of transport and storage due to the microbial life of these substrates. This creates a demand for more specialised substrates recipes with adjusted nutrition.

What are limitations of organic substrates in terms of transit and storage?

Substrates for organic growing have a high microbial activity. During transport and storage microbiological processes start which can change the substrates' chemical and biological properties. Typically, those processes are supported by favourable climatic conditions during overseas transport (e.g. high temperatures in containers, anaerobic situation in compressed bales). Thus, substrates for organic growing cannot be transported over long distances. Some issues after transport and storage may be:

- Loss of nitrogen, especially nitrate, and release only as ammonium from the fertiliser leading to subsequent ammonium toxicity
- Fungal growth on substrate and incorporated organic fertilisers
- Development of strong smell
- Toxic effects at germination stage of sensitive crops (e. g. lettuce)

Use the organic module concept

Due to these limitations, growers in countries outside Europe can choose the organic module concept of Klasmann-Deilmann. Substrate is delivered without vulnerable ingredients such as nitrogen fertiliser. The required organic fertiliser types are added to the final substrate when used by the grower.

Your benefits from Klasmann-Deilmann's technical support

- Testing and judgement of your locally available fertiliser types
- Providing recommendations for exact application and most suitable rates of the organic fertiliser
- Monitoring the process of mixing as well as the crop cultivation by analytical analysis
- Ongoing research on substrates for organic growing and organic fertiliser applications at Klasmann-Deilmann and sharing latest knowledge with our customers

READ MORE

- Technical Scripture: 'International Organic module concept'
- GreenNotes: 'Special substrate for organic cultivation'

FAQ SHOULD MEAN: FINE ANSWERED QUESTIONS

Frequently Asked Questions

Questions about physical and chemical aspects

During cultivation fine particles seem to accumulate at the bottom of the pot. What is the reason?

This phenomenon is known as “silt effect” and is typically a sign that the substrate structure is too fine. A too fine substrate in a large pot is prone to create this problem, often in combination with overhead irrigation, as the fine particles < 1 mm will accumulate at the bottom of a pot over time. This accumulation subsequently leads to a compacted area with oxygen deficiency for the roots and thus root-rot. The effect is related to the grade of the chosen substrate recipe and the amount water applied by overhead irrigation.

If the substrate is used for long term crops such as pot plants, shrubs and trees, it is suggested to use a product with an increased amount of sod peat fractions, GreenFibre® or perlite as this provides more structural stability and a reduction of fine particles.

Frequent heavy irrigation and a constantly wet substrate can lead to quicker decomposition and break down, even of a coarse substrate structure. Washing out fine particles to the bottom of the pot leads subsequently to the “silt effect”. In general and if possible, a dry cultivation of the plants is therefore recommended, overwatering should be avoided. This ensures better aeration of roots, less pressure from pests and diseases and a more stable substrate structure in the long term.

Beginning ‘silt effect’ at the bottom of the root ball due to accumulation of fine particles

Which constituent can be used to increase the air capacity and drainage of substrates?

Coco fibres and coir

Coco fibres increase the drainage of substrates and support water movement in the growing media similar to wood fibre. Coir improves drainage slightly, as it still provides significant water retention. Both can be used to increase drainage in substrates, but they need to be properly washed and treated to avoid high levels of sodium, chloride and potassium. Induced calcium deficiency and foliage damage by high salt levels may be a result if a poor coir quality is used.

Perlite

This constituent is pH neutral and absorbs neither water nor nutrients, thus it can be used safely in substrates if the content of heavy metals and micro elements is well controlled. Internationally, perlite is a very common constituent to increase drainage and air capacity.

Sod peat fractions

Specially harvested and processed peat raw material which provides a reduced amount of fine particles and a very high structural stability to ensure drainage and air capacity in substrates. Besides milled peat this is the most important constituent in well-structured substrates for pot plants, shrubs, trees or soft fruits where high structurural stability is required.

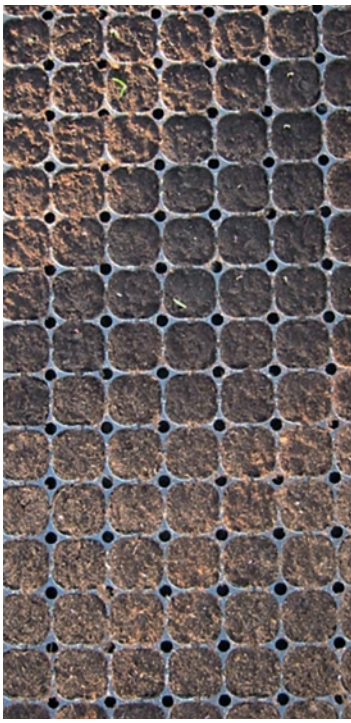
GreenFibre®

This constituent is a wood fibre produced by Klasmann-Deilmann and another optimal solution to increase drainage and air capacity with a very sustainable and cost-effective material. It also supports water distribution in the root zone and re-wetting of the substrate.

READ MORE

Brochure: 'A matter of experience - The basis for growing success'

When sowing in trays, cells are sometimes perceived as too dry or too wet. What can be done to avoid this?



The reason may be an inhomogeneous filling or compaction of substrate in the cells of the tray. The filling process should be carried out very carefully to have the same amount of substrate with the same compaction in each cell. Clean working processes and possibly automated filling lines support homogeneous germination, even water distribution and finally a uniform crop growth (See page 9 for more details of tray filling).

In automated filling lines it is advised to randomly control the weight of the trays after filling to confirm the consistency of the filling process and machine settings. There are recipes based on sod peat or perlite which provide better flowability and more structural stability to avoid too strong compaction. Choosing such a recipe can also help to prevent issues with moisture inhomogeneities in trays.

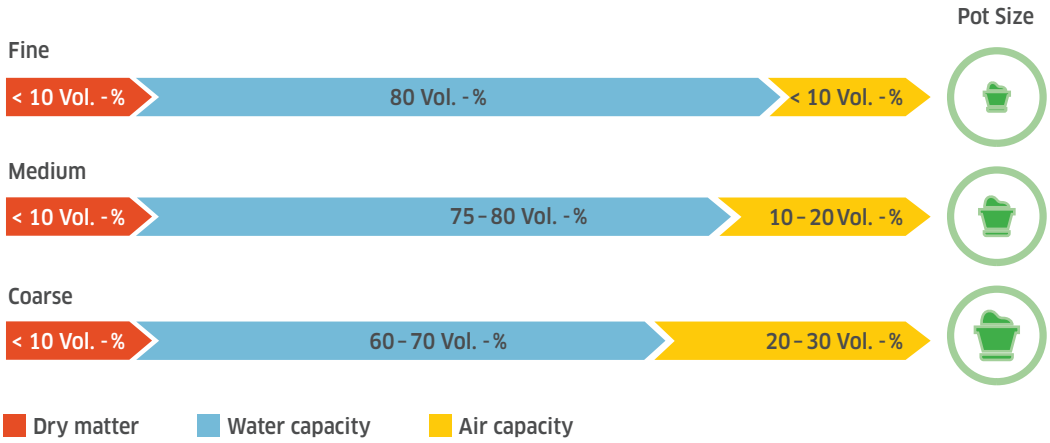
After filling, a stacking of completely filled trays can lead to inhomogeneous compaction of the substrate in the cells and thus to moisture variations during cultivation. Therefore stacking of trays should be avoided or a thin board should be used between the single trays.

After irrigation the substrate dries up quite slowly. What is the reason?

The reason could be that the substrate structure is too fine and thus stores too much water. Simply spoken, the finer the substrate structure the more water is stored - the coarser the substrate structure the less water but more air is stored. The substrate structure has to be suitable for the pot sizes. If it is too fine, the change to another substrate recipe with a more open, free draining structure may need to be considered. Moreover, make sure your irrigation scheme matches the substrate and water is not applied too often. Check the guidelines on irrigation on page 11 for more detailed information.

Contact your local representative for substrates of Klasmann-Deilmann for detailed support.

Recommended substrates structure for different pot sizes and related physical target values



The pH level of the substrate drops or increases during cultivation. Does this indicate a quality problem of the substrate?

A drop or increase of pH value in a substrate during cultivation is not related to the substrate quality itself, but to the effect of irrigation water and fertiliser types during cultivation. Depending on the water quality used on the nursery, the supply of bi-carbonates (HCO_3) and calcium carbonates ($CaCO_3$) can be different. So called 'hard' water provides high levels of carbonates which lead to an increase of pH value. Soft water with low levels of carbonates reduces the pH level in growing media over time due to chemical processes.

Another influencing factor for the pH value of the substrate during cultivation is the type of nitrogen used. Ammonium (NH_4^+) acts physiologically acidic and decreases the pH value, whereas nitrate (NO_3^-) acts physiologically alcalinic and increases the pH value. The physiological effect relates to the chemical exchange processes between substrate water solution and plant's roots where OH^- and H^+ ions are constantly exchanged.

Growing media based on peat moss are known for their high buffering capacity to avoid pH variations. This is due to the buffering complex of the organic matter and the amount of fulvic and humic acids. Other materials such as coir or wood fibre provide less buffering capacity and the pH value may drop faster and more strongly due to the cation exchange capacity (CEC).

General rules for effect of water and fertiliser on the pH of the substrate:

- Nitrate based fertilisation
- Hard water

} **= increase pH value in substrate during cultivation**

- Ammonium based fertilisation
- Soft water

} **=decrease pH value in substrate during cultivation**

How to control pH effects in substrates

1. Effects from irrigation water:
- Reduce content of carbonates by acidification (e. g. nitric acid, sulphuric acid, phosphoric acid). Reliable dosing equipment is required to prevent acid damage to the crop.
- Blend rain water (very soft) with borehole water (often hard) to reach medium carbonate levels.
- Consider monitoring of pH value in the substrate during cultivation when very hard and very soft water is used. An annual check of water quality is also recommended.
- Start with a higher or lower pH value in the substrate to counteract the pH influence of the water.

2. Effects from fertiliser types:
- Use specific fertilisers suitable for hard or soft water. These have adjusted nitrate/ ammonium ratios and support pH stability during cultivation.
- Consider liquid feed of nitrate or ammonium based fertilisers (e. g. calcium nitrate, ammonium sulphate) if significant pH variations have been observed.

READ MORE

- Technical Scripture: 'Peat moss and coir in horticultural substrates'

What needs to be considered when taking substrate samples for analysis?

Sampling in crops:

– At random, select 5 – 10 pots from each crop or batch intended for sampling to obtain an average sample of the substrate from these pots.
– Remove the top layer of substrate from each pot (approx. 1 cm, as salt and nutrients may have accumulated in this area influencing a correct interpretation of the results).
– Remove the substrate carefully from the roots and collect them in a clean bowl or bucket. Alternatively sample material can be obtained by cutting pieces out of each root ball (shaped as a piece of cake) – this method allows not to destroy the whole plant for sampling.

Sampling of unused substrate:

Big Bales, 70 L bags, 200 L bales

- Collect material from the top, middle and bottom of each pallet. This ensures to create a meaningful average sample for analysis.
- Cut the bag open carefully and take a few hands of material out of each hole. Alternatively, a sampling tube may be used, if available. The packaging must be closed with an adhesive tape after sampling to prevent water from entering the substrate.
- Mix sample material from 4 to 5 sampling points per pallet and take substrate from 5 - 7 different pallets per batch in similar manner.
- In certain cases it is advisable to test even all pallets in stock separately to potentially identify products out of specification.

Loose bulk

- Take sample material from 8 to 10 spots randomly spread across the pile of substrate.

Sample preparation for sending:

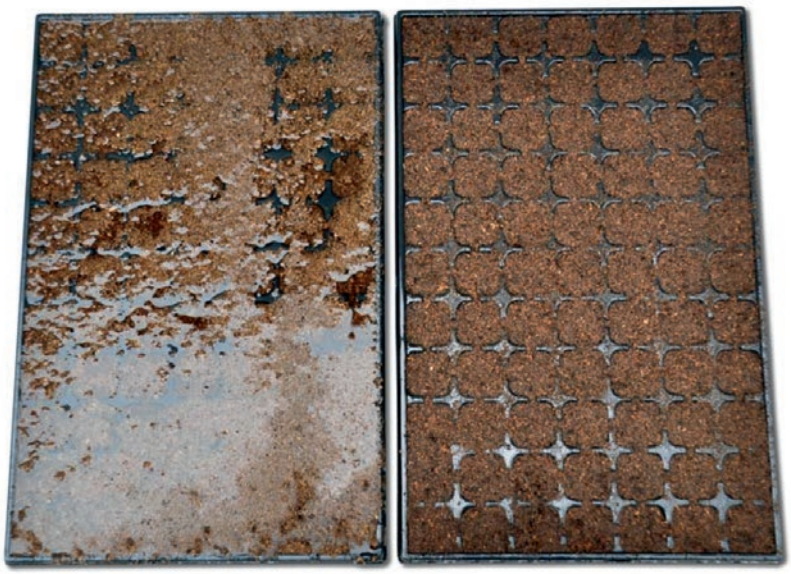
- Fill the substrate into a clean, unused polybag after mixing the whole sample material thoroughly.
- The size of the lab sample relates to the required analysis. pH, EC as well as full nutrient tests can be done with 1.5 liters. Special investigations such as physical or screening tests may require more material. This needs to be confirmed with the department Advisory Services or the central lab of Klasmann-Deilmann.
- The sample bag should be clearly labelled for later traceability of results.

Questions about additives

How long is the wetting agent effective in substrates?

Substrates from Klasmann-Deilmann contain a specific and highly effcient wetting agent called Hydro S. This additive is designed to ensure optimal initial wetting of substrates after sowing and transplating, but also during cultivation.

Substrate without efficient wetting agent – water droplets stay on substrate surface



Substrate with Hydro S wetting agent – water ist taken up by substrate immediately

In general, effectiveness can be expected at least 6 to 8 months after production, but depends on the storage conditions of the substrate. The wetting agent is based on a tenside that decomposes by microbial activity, especially under warm storage conditions. If the substrate is stored in direct sunlight and at high temperatures, the chemical composition of the wetting agent deteriorates more easily. Under such conditions the effectiveness of the wetting agent may decrease significantly after more than six months after production (compare recommendations for storage on page 15).

The aim of using a wetting agent in substrates is to support the rewetting especially in the first weeks of cultivation; its performance has to concentrate on this period. Once the root system in the pots has established, re-wetting of a substrate is easier, even without a wetting agent still being active. The general effect of a wetting agent is to reduce the surface tension of the water allowing water droplets to enter the substrate pores more easily.

READ MORE

– Product leaflet: 'Hydro S - The definition of high performance'

What is the longevity of the incorporated base fertiliser? When should further liquid feed begin after sowing or transplanting?

The longevity of the base fertilisation applied to the substrate depends on various factors. Based on the initial level of the specific recipe (e.g. 0.5 g/l type 12:14:24; 1 g/l type 14:10:18; 2 g/l type 15:10:20, etc.) further factors would be the crop type and its nutrient demand, the climatic conditions and the related speed of plant development. Therefore, a standard answer cannot be given. A guideline can be as follows:

- In general, the base fertiliser in propagation substrates is calculated to be effective for the first 10 – 14 days after germination. This applies e. g. to propagation substrates with a base fertilisation of 1 g/l type 14:10:18).
- Crops with quick initial development during the first days and thus a higher nutrient demand may require initial fertilisation after 8 – 10 days; slower crops require initial fertilisation only after 13 – 15 days.
- Most important is to monitor the crop in terms of growth to properly control the liquid feed. Leaf colour is an important parameter. As soon as it turns light green, further feed has to be given quickly on the nursery. Root development is also a good indicator. Once the root tips reach the outer surface of the root ball, liquid feed should start. Testing press water of substrate for salt concentration (EC) is generally also a measure to understand the nutrient availability in substrates.
- An NPK fertiliser with balanced nutrient ratio and trace elements should be used for further liquid feed to provide all necessary nutrients during cultivation. The inclusion of controlled release fertilisers (CRF) in the substrate can be considered as a measure to reduce the need for liquid feed. This is typically the case for long term crops grown outside such as shrubs and trees, but also for pot plants grown indoors in large pots.
- Substrates which have been stored for a while may already have a reduced nitrogen level due to the microbial process and related nitrate losses. If the substrate was stored for more than 6 months after production, liquid feed should start early to compensate for nitrogen losses. Typically, a feed with calcium nitrate solution (1 g/l) as a single measure helps to secure sufficient nitrate levels in the substrate for initial crop development. All other nutrients remain available even after storage.

Questions about biological aspects

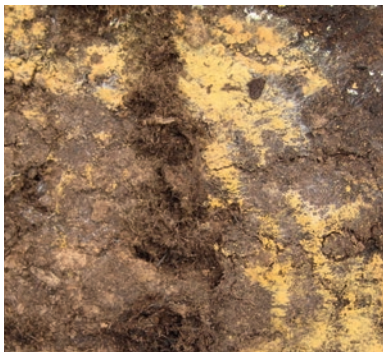
A white or brown fungal mycelium is found on the substrate surface. What needs to be done?

Fungal mycelium developing on the substrate surface is often related to the saprophytic fungi Peziza ostracoderma, Leucocoprinus birnbaumii and Athelia turficola. This may occur under certain climatic conditions inside the packaging during transport and storage or on the substrate surface during crop cultivation.

All these species do not cause any damage to crops; they are purely saprophytic, meaning they are not able to affect living plant cells but only dead organic matter. As professional horticultural substrates consist of a high amount of organic matter, they can naturally attract settlement and growth of spores from saprophytic fungi.

Athelia turficola

Leucocoprinus birnbaumii



Pezziza ostracoderma

Measures related to fungal growth when occurring in substrate bales:

- Loosen and mix substrate thoroughly in order to aerate it as much as possible. After aeration and some drying back, the mycelium collapses quickly.
- Base substrates may be used straight away for cultivation. They do not contain any base fertiliser and therefore no nutrient losses are to be expected in the substrate.
- Use growing media containing base fertiliser as usual while monitoring the nutrient supply for the crop, especially nitrogen. Fertilisation might need to be increased slightly to balance nutrient fixation by fungal growth.
- Do not use growing media showing very strong mycelium for propagation without further testing (e. g. for sowing, rooting of cuttings and growing on of plants from in-vitro propagation). A nutrient analysis and bio assay should be carried out to ensure the substrate is fit for purpose. Treatment with calcium nitrate is recommended to ensure a sufficient nitrate level for the initial development of young plants.
- As a matter of prevention use substrate always as fresh as possible and follow strictly the storage rules as per page 15.

Measures related to fungal growth when occurring during cultivation:

- Fungal growth during cultivation usually originates from airborne spores supported by moist conditions in the crop or greenhouse.
- In general, all measures - preventive and curative - should ensure a drier situation in the crop, especially of the substrate surface.
- A good aeration of plants and substrate allow the substrate surface to dry off quickly what is very important as saphrophytic fungi grow stronger in moist conditions.
- If possible, reduce relative humidity inside the greenhouse by good aeration and air circulation with ventilator systems.

Currently, there is no fungicide on the market that specifically combats saprophytic fungi. Fungicides against soil-borne pathogenic fungi show very little effect. Treatment with Azoxystrobin (e.g. Amistar®) can reduce the growth of saprophytic fungi to a certain degree. Test for plant compatibility prior to use for a crop.

READ MORE

- Technical Scripture: 'Measures against Peziza on the nursery'
- Leaflet: 'RHP Advice card saprothrophic fungi'

After opening the bale, the substrate had an unusual smell. What is the reason and what needs to be done?

Smell can occur in compressed peat based substrates after long transport or storage in unfavourable hot climatic conditions. The smell is comparable to rotten eggs or ammonia and a result of anaerobic microbiological processes in the compressed substrate supported by high temperatures and low oxygen levels. The smell results from chemical reduction of nitrate and sulphate by microbes due to lack of oxygen. Warm temperatures support these processes. Generally the tendency for smell in peat based substrates is influenced by following factors:

- Microbiological life in peat
- Temperature during transport
- Lead times of the cargo
- Storage conditions after arrival

The substrate can be used without limitations if following steps are considered prior to use:

- If products show this distincitive smell of ammonia, the substrate should be loosened up immediately to aerate the material. This aeration stops the process of chemical reduction and gaseous residues can diffuse.
- If possible, store the material in bulk for a day or two and turn it 2 to 3 times by shovel. The smell will disappear significantly during this aeration.

- **Measures for substrates used for potting and transplanting (medium, coarse and coarse-fibrous structure):**

  After sufficient aeration and release of gaseous residues there are no harmful effects to be expected for plant growth. The young plants used for transplanting will have a well rooted and developed root ball and are therefore not prone to any growth issues due to the smell.

- **Measures for substrates used for young plant cultivation:**

  Since seedlings are far more sensitive especially during the germination stage, these substrates should be tested with a chemical substrate analysis to confirm that nitrate as well as pH levels are still within acceptable limits. Ideally a bio assay with lettuce also confirms that germination will not get affected. Young plants may need to be fertilised with additional nitrate nitrogen (NO_3) at an early stage to balance any potential nitrate losses and avoid pure ammonium supply from the substrate.

READ MORE

- Technical Scripture: 'SOP smell in peat products'

Green algae appear on the substrate surface during cultivation. Why does this occur and what needs to be done?

Algae spores are always present in the environment as they are so called “ubiquitous” organisms. Possible sources can be irrigation water (especially when collected from the greenhouse roof), hose and pipes, greenhouse furniture and construction. Spores are also blown by wind from the surrounding environment.

Ideal conditions for development of algae are:

– pH level of 5 to 7 (algae die at low pH levels)
– Presence of nitrate nitrogen (NO_3), phosphate (P_2O_5) and CO_2
– Free available water (especially on horizontal surfaces)
– Warm conditions and high humidity in the greenhouse
– Shady areas

How to counteract algae growth:

- Keep crop as dry as possible (if required consider a coarser substrate structure to allow more drainage and air capacity in the root zone).
- Use as little water as possible inside the greenhouse.
- Ventilate as much as possible and reduce humidity.
- Ensure general hygiene in the greenhouse and on floor spaces for outside cultivation.
- Repair leaks of roofs, gutters, pipes, etc. to avoid free water in the growing area.
- Reduce shade where possible.
- Decrease risk of condensation.
- Cover water tanks.
- Add oxygen (O_2) to rainwater in order to drive out CO_2.
- Use filter for irrigation water prior to use (e.g. sand filter).
- Apply algaecide (mind its toxicity for crops, therefore run tests on small scale prior to general use).
- Cover seeds with vermiculite, perlite or washed sand if feasible for the specific crop to ensure a dry substrate surface.

Development of algae and liverwort under moist growing conditions

What is the reason for occurrence of sciarid flies (fungus gnat)? Can the substrate itself contain eggs of Sciara? What measures are recommended to prevent the occurrence of sciarids?

Sciarid flies naturally occur in or around buildings, in greenhouses, nurseries and interior plantings. They are strongly attracted by moist organic matter (such as peat moss or green compost) to lay their eggs. Especially a moist substrate surface covered with algae or fungal mycelium creates an optimal situation for sciarid flies since the flies feed from both, algae and mycelium (hence the name fungus gnat). Therefore the combination of moisture, decomposing organic matter, algae and fungal growth on the substrate surface or nursery floor typically is the main reason for the settlement of sciarid flies. Organic fertiliser mixed into the substrate or from applied liquid feed increases the attractiveness during cultivation due to the attractive smell. The unused substrate itself does not provide sciarid flies or eggs. Sciarid flies develop within just 21 days over 4 development stages (egg -> larvae -> pupa -> adult) and therefore build up populations quickly with many generations per year. The damage in crops is mainly caused by the larvae which feed from the roots of the plants. Good control in the greenhouse is necessary to avoid the development of populations.

How to control sciarid flies and larvae:

- Cultivation methods should reduce moisture and free water in the greenhouse and crop.
- Strictly remove all plant debris from the greenhouse or floor area to avoid attracting Sciara flies.
- Avoid over watering – if necessary, improve drainage by using a coarser substrate structure to allow more drainage and air capacity in the root zone.
- Include sufficient time after irrigation to allow the crop and substrate surface to dry off.
- Avoid areas of free water and eliminate water leaks in the nursery to reduce algae growth.
- Remove algae from the floor area, doorways and greenhouse equipment.
- Moist and decomposing grass clippings, immature green compost, organic fertilisers and mulches are popular breeding places. Avoid them in and around the greenhouse.
- Use yellow boards to control the population of sciarid flies in the greenhouse.
- Combat larvae in the substrate with a drench of products containing ‘Steinernema feltiae’ predator nematodes or ‘Bacillus thuringiensis’ bacteria.
- The installation of meshes in windows and ventilation facilities as well as arranging locks in entrance areas help to manage flies and insects to enter the greenhouse.

READ MORE

- Technical Scripture: ‘Reasons for sciarids in organic substrates and measures to reduce pressure on the nursery’
- Technical Scripture: ‘Ecological reduction of Sciara population’

Why is it not necessary to disinfect substrates based on sphagnum peat moss?

One of the main benefits of sphagnum peat moss is its biological cleanliness and the absence of harmful pests and diseases as well as human pathogens. This is due to the development process of raised peat bogs in specific conditions. Due to this development, the natural peat moss provides only very low nutrient levels and a low pH level. For most pests and diseases the pH level is too low to emerge. The specific conditions in a peat bog (waterlogged, low pH, no nutrients) do not allow any plants other than the specific sphagnum varieties and some peat grasses. Therefore, the common pests and diseases are not found in sphagnum peat moss and this is the reason, why disinfection is not required. Within the RHP quality system, which Klasmann-Deilmann applies to all their peat fields, peat raw materials, constituents and final product, the monitoring of pests and diseases is an essential part and all substrates supplied to growers are fully controlled also in terms of hygiene.

Another important aspect to consider is that thermal or chemical treatment of peat or substrate would destroy the positive microbial activity. This natural microbial activity provides some antagonistic effects against pests and diseases but also against saprophytic fungi. Disinfection of substrates would remove this advantage and is therefore not recommened.

Are there any harmful nematodes in substrate from Klasmann-Deilmann?

Products from Klasmann-Deilmann do not contain any plant pathogenic nematodes. However, they may contain saprophytic nematodes which do not have a mouth sting and therefore cannot harm living plants. Saprophytic nematodes can be found in many constituents worldwide. The monitoring of nematodes in substrates from Klasmann-Deilmann is also part of the strict quality control standard based on the RHP quality system. Moreover, external investigations are frequently carried out by the plant protection office to comply with national import and export regulations. Therefore, substrates from Klasmann-Deilmann can be confirmed to be free from any pathogenic nematodes.

Sometimes weeds occur in pot plants. Do they come from the substrate?

The weed content in all raw materials used by Klasmann-Deilmann is constantly controlled as it is a parameter within the RHP quality system. Especially in the peat bogs, a careful field management is implemented to avoid the occurance of grasses and other plants. Regular mechanical weed control is carried out. Chemical herbicides must not be used in order to avoid any residues in the peat raw materials. Moreover, the low pH value and lack of nutrients in a peat bog do not allow many plants to grow, so peat moss is a naturally clean material. Substrates from Klasmann-Deilmann can therefore be declared almost free from weed according to RHP quality standards.

Weeds occurring in a crop usually originate from plants growing in the surroundings of the nursery or even in the greenhouse (e. g. under cultivation tables, in doorways, along pathways etc.). Therefore, a clean cultivation area both, indoor and outdoor, is essential to prevent weed seeds from spreading and germinating in the crop. Regular monitoring and weed control are therefore essential for nursery hygiene.

READ MORE

- Leaflet: 'Why RHP substrates'
- Declaration: 'Phytosanitary Declaration' of Klasmann-Deilmann
- Certificate: 'RHP certificate KD GmbH'

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