The Suitability of Coir Peat as a Substrate for Bedding Plant and Perennial Production©

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PROBLEMS WITH COMPOSTED PINE BARK SUBSTRATE

The substrate we used, composted pine bark mixed with 10% vermiculite, gave inconsistent results. It was difficult to manage the pH and EC levels because:

- Quality of composted bark supplied was inconsistent.
- pH was very low, often below pH 5.5.
- Downward pH drift during cultivation.
- EC levels in packs and pots remained low, also after pre-enriching and adding fertilizer with each watering.
- Air-filled porosity varied a lot, often too many fines were resulting in poor oxygen availability in the root area.

In our efforts to find a solution to these problems we first reviewed the basics to ensure we understood what was happening. This knowledge also helped us to better evaluate other substrate possibilities. We decided to investigate the suitability of coir peat.

BASIC PLANT GROWTH REQUIREMENTS

The basic requirements needed to grow plants include: light, temperature, relative humidity, water, substrate, fertilizer, and genetics.

All these factors have an influence on plant quality. A grower has less control over the first three factors and more control over the last four. To minimise risk in production a grower should take control of water quality, the type of substrate, fertilisation, and the choice of genetics.

DEFINITIONS OF BASIC CONCEPTS RELATING TO WATER QUALITY, SUBSTRATES, AND FERTILIZATION

pH (Potential Hydrogen).

- It is the acid value or a measurement of the concentration of the hydrogen ions (H+).
- The higher the concentration of H+ the lower the pH value and the more acidic.
- The pH scale ranges from 0–14. A pH of 7 is neutral, below 7 is acidic and above 7 is alkaline or basic.
- pH is a negative logarithm, pH 5 is 100 times more acid than pH 7; pH 4 is a 1000 times more acid than pH 7.

- pH affects nutrient solubility and availability to plants.
  - Low pH causes micro-element toxicity and deficiency of calcium and magnesium.
  - High pH causes nutrient deficiencies and may promote the spread of diseases, e.g., *Thielaviopsis*
- Ideal pH range for most plants is between 5.5 and 6.5.

Electrical Conductivity (EC).

- It is the value of the total dissolved salts/elements in the water or substrate.
- It is measured in microSiemens·cm^{-1}.
- It does not determine fertility; fertility can only be determined by analysing the chemical composition of the water or substrate.

Alkalinity: Buffer Capacity.

- It is a measure of the water or substrates ability to neutralise acidity or ability to buffer against pH changes.
- It is a measurement of the levels of bicarbonates, carbonates, and hydroxides; **e**xpressed as ppm or mg·L^{-1} of $CaCO_3$ (calcium carbonate).
- Levels between 30–180 mg·L^{-1} are optimal, depending on the container size.
- Water or substrate with high alkalinity always has a high pH.
- Water or substrate with a high pH can have a low alkalinity level.
- Water with high pH but low alkalinity will not affect the pH of the substrate, it has little ability to neutralise acidity (H+).

Cation Exchange Capacity (CEC).

- It is the measure of the ability of substrate to hold and release cations (positive charged nutrients such as calcium, magnesium, potassium, sodium).
- Expressed in milli-equivalents (meq)/100 g^{-1} of soil.
- Soilless substrates and sand have a low CEC.
- Typical CEC values for some media components: perlite: 1.5 meq·100 g^{-1}; peat: 125 meq·100 g^{-1}, coir: 60–130 meq·100 g^{-1}.

Water Holding Capacity (WHC).

- It is a substrates ability to hold water.
- It is the amount of pores of a substrate's total volume taken up with water.
- Substrate with low WHC reaches saturation point quicker and some nutrients are leached out with the excess water disposed.
- Higher WHC results in less leaching of nutrients.

Air Filled Porosity (AFP).

- Percent of pores filled with air in a saturated substrate.
- The ratio between air : water : solids in a substrate, is very important.
- If not enough air is available, the substrate is waterlogged, and roots cannot grow.
- Small pores tend to fill completely with water, large pores tend to drain, allowing air back into the substrate.

CHARACTERISTICS OF A SOILLESS SUBSTRATE

a. Physical Properties

Moisture	60%–75%
Organic matter	80%–90%
Bulk density	100–125 $kg \cdot m^{-3}$
Shrinkage (volume change)	<30%
Pores	>70%
Air filled porosity	16%–25%
Easy available water	25%–35%

b. Chemical Properties

Optimal pH	5.5–6.5
Optimal EC	0.6–1.2
Optimal Alkalinity	30–180 $mg \cdot L^{-1}$

c. Phyto-hygienic Properties

Must be free of: weeds, fungi, viruses and bacteria, pests, and nematodes

PROPERTIES OF COMPOSTED PINE BARK

- pH generally of 5–6.5, it is acidic.
- Low EC, low initial fertility.
- Low WHC.
- Becomes water repellent when dry.
- Composted pine bark represses pathogenic fungus.
- Least stable and most susceptible to degradation (similar to composting) of all materials commonly found in substrates.
- The degradation or composting process tends to be very acidic and absorbs all nitrogen present (nitrogen fixation).
- Downward drift of pH common in poorly composted pine bark.
- Fresh pine bark contains phenolic compounds (tannins) which are toxic to plants, the composting process removes these toxins.
- Aging in large, static heaps that become anaerobic in the middle can lead to the production of organic acids within the heap, which render the bark toxic to plants.

Problems with Local Composted Pine Bark Supply.

- Inconsistent quality; no reliable quality control standards are in place.
- Aging or composting period not consistent, which may result in:
  - Variations in pH and downward drift of pH.
  - Toxicity due to tannins and organic acids.
  - Nitrogen fixation.
  - Amount of fine particles varies, which influences AFP.

PROPERTIES OF COIR PEAT

- Coir is the fibrous material of the coconut fruit. The short fibres and dust or pith, are bi-products of the coconut fibre industry and are suitable for the use as a growing medium in horticulture.
- It is a completely homogenous material.

- Texture is consistent and uniform.
- Retains moisture well; coir is composed of millions of capillary micro-sponges that absorb and hold up to nine times its own weight in water.
- It has up to 27% of easily available water.
- Coir peat will hold and release nutrients in solution over an extended period of time without re-watering.
- Maintains excellent AFP (18%–23%).
- It has a natural pH of 5.7 to 6.5.
- Coir peat has a naturally high lignin content which encourages favourable microorganisms around the root zone.
- It has a very low alkalinity (low in bicarbonates), with very little buffering ability against changes in pH.
- To improve the nutrient exchange complex of coir it is recommended to add calcium sulfate ($CaSO_4$, gypsum) at 1 $kg \cdot m^{-3}$ and magnesium oxide (MgO) at 500 $g \cdot m^{-3}$, during the expanding process.
- Untreated coir peat tends to be high in both sodium and potassium, compared to the other peats, but Na is leached readily from the material under irrigation.
- It contains very little calcium (Ca).
- The chemical properties of coir peat can vary widely from source to source. A reliable source supplying consistent quality is important. Best is to buy only from an ISO certified supplier.

OBJECTIVE OF TRIALS

- Can coir peat be used as an alternative to composted pine bark?
- Does a mixture of coir and bark give better results than using plain bark?
- Comparison of different grades of coir.
- Get a better understanding of the properties of coir and bark.
- Cost comparison between coir and bark.

Trial 1. A comparison of different grades of GreenSoil's coir samples. Planted pansies in 6 packs and Bacopa in 15-cm pots with:

- 100% coir.
- 100% bark.
- Bark and coir (3 : 2, v/v) mix.

Trial 2. *Primula malacoides* planted in 6 packs with:

- 100% coir.
- 100% bark.
- Bark and coir (3 : 2, v/v) mix.

Trial 3. Annuals in 6 packs and perennials in 4 packs planted with:

- 100% coir.
- 100% bark.
- Percent coir mixed with bark: 20%, 30%, 40%, 50%, 60%.

TRIAL PROCEDURES

For all trials the following was done:

- 8-mm "seedling grade" composted bark was used.
- Coir peat supplied by GreenSoils.
- Substrate mixes pre-enriched with Osmocote Start and Osmocote Exact 3–4 months.
- Fertilizer applied with each watering, using A & B tank, with calculated recipe based on water analysis.
- Weekly monitoring of pH and EC levels in substrate.
- Monitoring of growth performance of plants, checking root and leaf development.

CONCLUSION OF TRIALS

- Coir peat can successfully be used as an alternative to composted pine bark
- Coir peat added to composted pine bark does improve the properties of the substrate substantially
- Best coir grade for packs, pots, and rooting cuttings was $^{3}/_{4}$-in. mesh, single sieved with long fibers and up to 20% fines, with an AFP of about 20%
- Water management is very important:
  - Bark substrates need more frequent watering
  - Coir substrates need less frequent watering
- Coir substrates showed higher EC in pots
- Coir substrates showed less pH downward drift
- Grade fine $^{1}/_{4}$-in. mesh, single sieved: suitable as a germination medium
- Cost of coir peat depends on ZAR/$ exchange rate, currently the delivered cost of coir from a reliable supplier in Sri-Lanka to Gauteng, is about the same as that of composted pine bark supplied by local suppliers.
- Good quality plants may also be grown in composted pine bark, but due to its natural properties, there are too many variables that are difficult to control. This could result in poor quality plants or complete losses.

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