Suitability of rice hulls and coco peat as alternatives to peat

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Summary

Peat is the most important constituent for the production of horticultural growing media because of its excellent characteristics. Due to public concern, however, there is a pressing need to reduce the use of peat. Consequently, producers of growing media are forced to search for alternatives to peat. Rice hulls and coco derivates (fibres, pith or chips) have been proposed as promising alternatives to peat, however their adoption for the production of growing media has not been fully established. While rice hulls are not always available in substantial amounts, coco derivates are quite expensive and may not be more environmentally friendly than peat due to transport. However, when used in appropriate quantities, rice hulls and coco products can be used in combination with peat. Nevertheless, peat remains the main constituent for the production of growing media because of its excellent technical and economical aspects.

Key index words: growing media, alternative raw materials, rice hulls, coco peat, peat

Introduction

The European Commission for Standardization (CEN, 1999) has adopted the definition of growing medium as "material other than soil in situ, in which plants are grown". Many kind of constituents can be assigned as "appropriate material other than soil", however peat is by far the most important one. Its excellent physical and chemical characteristics create a unique rooting environment for plants. Due to public concern, however, there is a pressing need to reduce the use of peat in order to minimise the effects of peat extraction on peat bog habitats. Governments and nature conservation groups urge producers of growing media to search for alternatives to peat. Compost, bark, rice hulls and coco derivates for example have been proposed as promising alternatives to peat, however only a few have reached a significant level of adoption by substrate producing companies. While some substrate producers claim to continue working only but with peat, others use their particular alternative raw material as brand mark for their company. Does it imply that these latters are more concerned about environment or is their choice merely based on economical motivations? Maybe both. In this study, we discuss the advantages and disadvantages of alternative raw materials, in particular rice hulls and coco peat, for the production of growing media from the producer's point of view.

Availability of alternative raw materials

Before replacing peat by an alternative constituent, producers of growing media have to be aware of the availability of alternative raw materials. Coco derivates for example are considered as renewable resources and thus their availability is in the long term (in theory) not endangered. They originate from the tropics and are produced year round due to the warm and humid climate. Apart from possible transport problems, the availability of coco derivates on the European market is always ensured.

Rice hulls are a by-product from the rice hulling mills and are obtained when the rice hulls are removed from the rice paddy. Rice hulls are available in substantial amounts in Europe: the cultivation of rice accounts for more than 574 000 ha or 3.4 million tons per year (Ferrero, 2005). The most important European rice producing countries are situated around the Mediterranean Sea including Spain, France, Greece and Italy. Rice is harvested in September and October, which means that rice hulls are available from December. Consequently, the supply of rice hulls clashes with the demand of the substrate producing companies. Unfortunately, due to severe price increases in the energy sector, rice hulls are highly demanded as biomass and are no longer readily available.

Effect of alternative raw materials on plant development

The incorporation of alternative raw materials in substrates may significantly influence the physical and chemical characteristics of growing media. Table 1 gives an overview of the physical and chemical properties of three substrates: a standard substrate based on peat, the standard substrate amended with 20% rice hulls, and the standard substrate amended with 20% coco peat.

Table 1 shows that the introduction of rice hulls and coco peat significantly increase air content of the standard substrate. The water retention at pF1, however, was slightly decreased. Rice hulls and coco derivates increase the availability of nutrients, however, this effect is minimal and neutralized after the first fertilization by the growers.

In order to evaluate the suitability of rice hulls and coco peat for the production of growing media, plant

Table 1. Overview of the physical and chemical characteristics of three different growing media*

	Standard	Standard + 20% rice hulls	Standard + 20% coco derivates
Air content	36%	48%	43%
Porosity	90%	93%	94%
Shrinkage	22%	20.5%	20%
Water retention pF1	54%	45%	50%
pH	5.96	5.96	5.62
EC (µs/cm)	290	320	350
N (mg/l)	99	109	119
P (mg/l)	58	64	70
K (mg/l)	113	125	137

*analyses were carried out according to the method of Gabriels & Verdonck (1991).

experiments were elaborated in collaboration with CEPEM (Centre d'expérimentation pour la pépinière méridionale, Avignon, France). A standard nursery substrate based on peat and bark was modified using 20% coco peat and 20% rice hulls. Different nursery plants were used to evaluate the suitability of the raw materials for growing media (Fig. 1).

Fig. 1 demonstrates that plant growth is highly dependent on the composition of substrates. Each composition significantly influenced plant growth in either positive or negative way; no tendency could be observed. The incorporation of 20% rice hulls in a standard substrate stimulated the growth of *X. Cupressocyparis* leylandi, but had a rather adverse effect on the growth of *Rosemarinus officinalis*. Compared to the standard substrate, an amendment of 20% coco peat significantly stimulated plant growth of all nursery plants, except for lavandula. Preliminary results of plant experiments demonstrated that rice hulls could only be incorporated in growing media at a maximum volume concentration of 20% (data not shown). Coco peat can be used at higher percentages if the quality (buffering) of the coco peat is well controlled.

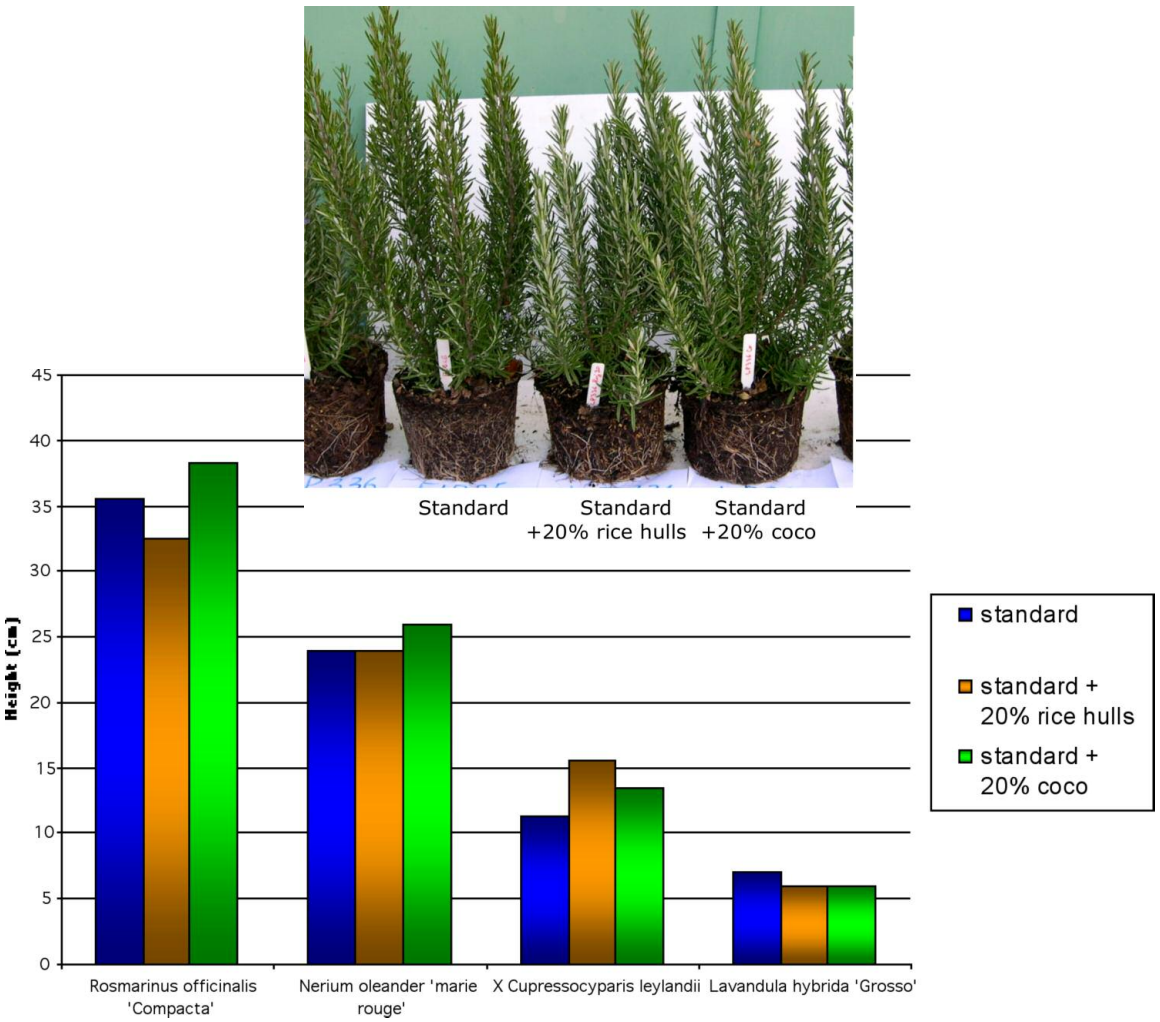

Figure 1. Effect of substrate composition on the growth of nursery plants

Impact of alternative raw materials at economical level

The introduction of alternative raw materials in growing media brings along a lot of changes for substrateproducing companies. Apart from the extra investments (additional storage room, research and development, quality control, etc.), the use of alternative raw materials has a substantial impact on the production process of growing media. For example, light products such as rice hulls are difficult to handle and are easily compressed, resulting in significant volume losses. The low bulk density of rice hulls makes transport quite expensive.

When alternative raw materials are available on the local market (rice hulls, bark, wood chips) their price is relatively low compared to peat. Rice hulls, depending on the region within Europe, may be 30% cheaper than peat. Contrary, coco derivates are due to the high transport costs more expensive than peat. Intriguingly, despite the positive effect of coco derivates on plant growth, growers are not always ready to pay more for substrates based on coco derivates.

Whereas peat has excellent physical and chemical properties for plant growth, the intrinsic properties of alternative raw materials may be too deviated for optimal plant growth. Coco derivates may have a high salinity level due to the fact that palm trees are often planted at the beach site. If coco derivates are not properly buffered, the high amounts of chloride may be lethal for plants. Rice hulls, when deriving from a non-parboiled process, cause severe damage to the production of plants due to the germination of remaining rice grains. The rice weeds compete with young plants for nutrients and sunlight. Growers are therefore obliged to remove the rice weeds one by one, a very labour intensive work. All these inherent properties may lead under certain circumstances to substantial production losses for growers.

Impact of alternative raw materials at ecological level

It is sometimes stated that the extraction of peat has an adverse impact on nature, since peat bogs are drained and the natural habitat of unique fauna and flora species is disturbed. In addition, during the extraction of peat, gasses such as carbon dioxide and other greenhouse gasses might be emitted. Today, the extraction of peat is clearly regulated by European and national legislation. Permits are given only if sustainable extraction management and after-use plans, including restoration of peat bogs have been agreed by the legal law enforcement authorities (CoConcept, 2008)

The impact of rice hulls on the ecosystem is rather low compared to peat, on condition that they are not transported over long distances. This depends on where you are located in Europe. Rice hulls are excellent alternative raw materials for substrate companies that are located close to rice mills. One marginal side note: rice hulls deplete nitrogen. Growers need to fertilize frequently to ensure sufficient amounts of nitrogen for the plant, which may result in percolation of nitrogen to the groundwater.

Coco derivates derive from tropical regions. Today, Asia is the leading manufacturing of coconut raw materials. Since coco derived products are considered as renewable resources, the CO_2 emission is rather low. Contrary, the transport over thousands of kilometers by sea ensures that coco products are not that environmentally friendly. According to the Basic Green study carried out by the RHP (2006), the life cycle analysis of coco products did not differ from the life cycle analysis of peat. Still, producers of substrates can reduce their own ecological footprint by consciously choosing their supplier. Nowadays, qualitative coco derivates for the production of growing media are offered in West-African countries, many kilometers closer to Europe.

Finally, the production of plants in West Europe is very energy consuming since greenhouses need to be heated. In addition, huge amounts of fertilizers and pesticides are used. Imagine the environmental impact when a grower has to restart the production of plants due to inappropriate use of alternative raw materials in growing media.

Conclusion

Many studies (Abad *et al.*, 2005; Marianthi, 2006; Noguera *et al.*, 2000) , including this one, demonstrated the suitability or non-suitability of alternative raw materials for the production of growing media. When applied in appropriate quantities, coco peat and rice hulls can certainly be used for the production of growing media, however, they can not replace peat entirely. Peat remains the main constituent for the production of growing media. The adoption of alternatives brings along a lot of changes for the grower ánd the substrateproducing companies, however, they can be dealt with. So far, the impact of the use of raw materials including peat, rice hulls and coco derivates on economy and environment remains unclear. Despite the fact that we tried to discuss some aspects in this paper, we are convinced that there are many more aspects to be discovered. Therefore, we encourage the elaboration of a detailed study on this rather difficult issue.

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