Early learnings about coir reuse trials

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- This project was set up to investigate the opportunities for the reuse of coir
- Some of the early learnings from this work are discussed in this project update
- Alternatives to coir are also being evaluated as part of this project

Tasmania's strawberry producers widely rely upon hydroponic production systems because they allow growers to closely control the nutrition, and water availability of strawberry plants. Hydroponics also increases productivity and reduces losses to pests and diseases. Harvesting is not influenced by weather and picking costs are lower, compared to soil culture. Within these systems, the choice of substrate (soilless growing medium) can greatly influence water retention and drainage, aeration, root gas exchange, and susceptibility to pests and diseases.

The use of coir (coconut fibre) has been commonly adopted in Tasmania due to access to ample supply from India and Sri Lanka, low cost, favourable water holding capacity, and drainage characteristics. Due to the relatively low cost, growers could afford to replace the coir substrate annually, providing them with a sterile material they could plant into to minimise plant exposure to possible substrate-borne pests and diseases.

In 2020, growing supply chain disruptions and rising costs for coir prompted some of Tasmania's strawberry growers to review how they use coir and consider options for reusing or replacing coir from local sources within their production systems to drive a better return on investment.

Key questions were:

- *Does coir physically hold up enough to consider reuse?*
- *What can / should we be mixing or replacing it with to improve its properties?*
- *Is sterilisation warranted before reuse?*

Forming a team of growers, research providers and industry representatives, the group was able to secure funding through the Tasmanian Government's Agricultural Development Fund to investigate the opportunities. Some of the early learnings from this work are discussed in this project update.

Physical properties and structural suitability of reused coir

Initially, the project research established that coir used for one season does not pose a disease risk to strawberries if reused. Then strawberry producers wanted to know how quickly coir degraded with use, and whether the water holding capacity (WHC) and drainage properties of reused coir were still suitable for supporting strawberry production. They also wanted to understand how fresh and used coir compares to a new wood fibre product that was trialled. To gain a better understanding of the physical properties of the materials, the group brought in soil physics experts from the Tasmanian Institute of Agriculture to characterise the hydraulic properties of both new and used coir which had already been used for one season and wood fibre.

Samples of each material were tested to determine their saturated hydraulic conductivity to measure WHC and drainage properties of both materials (Table 1). Saturated hydraulic conductivity represents the downward movement of water through the substrate at saturation. Notably, the used coir appears to have higher saturated hydraulic conductivity than the new coir, possibly due to root growth creating continuous pores, or decay of material resulting in pore creation.

Conductivity rates for both substrates were very high, with hydraulic conductivity greater than 120 mm/hr. This rate was in line with that of other substrates used in nurseries and for hydroponics, but is considered very rapid compared to soils (Hazelton & Murphy, 2007).

Both materials also demonstrated high levels of drainable porosity (Table 2), which represents the volume of air space need for roots to breath after the soil has drained from saturation. Used coir substrate demonstrated a higher level of drainable porosity than new coir, indicating that air capacity remains adequate to support root healthy function. When combined with the extremely high saturated hydraulic conductivity, these properties suggest that the ability of coir material which has been used for one year to rapidly drain from saturation is not likely to substantially differ from new coir material.

With regards to moisture retention within the coir substrate, new and used coir showed no differences in saturated moisture content and drainable porosity, but significant differences were observed in the volume of readily available water (RAW; -5 kPa to -30 kPa) accessible by plants to support rapid growth, as well as deficit available water (DAW; -30 kPa to -1500 kPa) accessible by plants to support slow growth, maintenance and survival during drought. Used coir was able to store greater volumes of readily available water retained within the substrate, reflecting the formation of larger water-storing pore spaces within the substrate.

When considered in conjunction with attributes relating to drainage, these results suggest that coir substrate which has been used for one year remains just as well suited for strawberry production, with drainage and moisture holding attributes which remain at least as good as new coir substrate. Further research is also planned to see if these properties continue to persist at the end of two or three years of usage.

Commercial alternatives to coir

Growers sought to understand what other materials were available which might partially or wholly replace coir. Wood fibre was identified for further physical assessment as (1) an unmixed product, and (2) wood fibre mixed with coir at two different proportions (25% wood fibre and 50% wood fibre).

Tests of wood fibre indicated greater saturated hydraulic conductivity and a higher proportion of drainable porosity within the structure of the substrate, with very little water able to be retained inside the substrate at pressures which plants can extract. Water retention was able to be increased by the addition of coir to the wood fibre, although these blends recorded less water retention at pressures between -5 kPa and -30 kPa and remained significantly below both new and recycled coir. See Table 1 & 2

Table 1. Bulk density & water saturated hydraulic conductivity of new & used coir substrates

Volume of available water (v/v)	Bulk Density	Saturated hydraulic conductivity
	(g cm^{-3})	Flow rate (K_{sat}) (mm/hr)
New Coir	0.096 ± 0.003	586.8
Reused Coir	0.085 ± 0.005	1533.0
Wood Fibre	0.204 ± 0.010	1105.9
25% wood fibre + 75% new coir	0.134 ± 0.004	468.3
25% wood fibre + 75% used coir	0.090 ± 0.005	3056.0
50% wood fibre + 50% used coir	0.111 ± 0.007	3607.9

Table 2. Saturated moisture content and extractable moisture content with new and used coir substrates at different matric potentials

Volume of available water (v/v)	Saturated moisture content	Drainable porosity	Readily available water content (RAW)	Deficit available water content (DAW)
Matric potential / extraction pressure	**0 kPa (vol / vol)**	**0 to -5 kPa (vol / vol)**	**-5 kPa to -30 kPa (vol / vol)**	**-30 kPa to -1500kPa (vol / vol)**
New coir substrate	0.80 ± 0.03	0.16	0.26	0.23
Reused coir substrate	0.78 ± 0.01	0.37	0.29	0.19
Wood fibre substrate	0.83 ± 0.00	0.44	0.08	0.21
25% wood fibre + 75% new coir	0.83 ± 0.01	0.34	0.23	0.17
25% wood fibre + 75% used coir	0.77 ± 0.00	0.41	0.20	0.22
50% wood fibre + 50% used coir	0.76 ± 0.02	0.39	0.16	0.20

The physical and chemical properties of a range of substrates included in the 2023/24 season will again be tested.

To gain an understanding of how to best implement reused coir within their respective production systems, growers involved with the project have set up several small trial areas for the 2023/24 season. Substrates being tested include new coir and reused coir on their own, as well as in combination with either fine wood fibre (a finer grade than in 2023) or composted pine bark. Comparisons between plastic-wrapped slabs and troughs are also being run, since troughs support the mixing and recycling of substrates and assist growers in reducing plastic waste from their production systems.

Plants in 70% wood fibre and 30% reused coir

Plants in 30% wood fibre and 70% reused coir

Plants in 100% reused coir

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Pest and disease risks

Choosing to plant into reused coir may mean accepting a higher level of root disease exposure, and potentially greater impacts from pests such as nematodes on plant health and survival.

Within a conventional hydroponic system, coir would usually be used for a single production season, before being replaced each year with new disease-free material.

Growers were initially uncertain about the nature and level of disease likely to be present within reused coir, so sought to learn more about:

- *what pests had the potential to be present in reused coir*
- *what the unmanaged impact of these pests were*
- *whether a sterilisation treatment would be needed*
- *what the most cost-effective method of sterilisation might be, if required*

Growers expressed concern that the presence of soil-borne pests would quickly infect strawberry runners and plug plants as they became established, resulting in higher rates of stunting, and seedling or runner death.

To identify which disease-causing pests and diseases were likely to be present, samples of used coir were taken from producers and sent to a laboratory for genetic testing. Results from this testing identified that a low level of *Pythium* spp. (including *Pythium clade F*) occured in more than half of all samples tested. Other soil-borne strawberry pests were also detected in very low numbers, including root knot nematode (*Meloidogyne* spp.), charcoal rot (*Macrophomina phaseolina*), and Rhizoctonia (*Rhizoctonia solani*).

The project also developed a desktop review of different treatment options growers can use for circumstances where growers have evidence that sterilisation is required. This report considered a range of treatment types including direct heating, microwaving, composting, fumigation, and chemical applications, as well as the pros and cons of each method.

Consideration was given to the effectiveness, cost and scalability of each treatment within the context of large berry production operations, as well as how these approaches might be carried out in a field environment without creating excessive labour and material handling costs.

To help growers to understand whether the impacts of pest presence warrants the application of a sterilisation treatment, plants within each of the used coir trials are being monitored for signs of root diseases, with the incidence rate compared to that of the commercial plantings grown in new, sterile coir.

Plants growing in both new and old coir are also being measured for crown diameter and number to help identify any changes in plant health and vigour potentially resulting from disease presence.

Early indications from these trials have been positive, with growers and research partners not observing any signs of root diseases. This suggests that the level of risk may be low, but substrates from each trial will be sampled for follow-up testing for the presence of pests and diseases at the end of the 2024 season.

Next steps

Armed with a better understanding of the likely risks and benefits of coir reuse and available alternative substrate options, growers are now undertaking several pilot trials to better understand strawberry growth, behaviour and productivity when planted into reused coir and coir-wood fibre blends compared to fresh coir substrate. Findings from these trials will inform the set-up of targeted commercial trials throughout 2024-25.

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