WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Comparison of Coconut Coir and Soil Cultivations for Hemp Production: Plant Growth and Production Yield

Yuttasart Inkaew [a], Arthitaya Kawee-ai [a*], Supakiat Supasin [a], Tanachai Pankasemsuk [a]

[a] Division of Cannabis and Medicinal Plants for Local Development, Graduate School, Payap University, Chiang Mai 50000, Thailand
DOI: https://doi.org/10.55248/gengpi.5.0324.0619

A B S T R A C T

Most farmers prefer the use of organic substrate over natural soils when growing crops such as hemp in an outdoor plantation. The objective of the study was to determine the effect of coconut coir substrate on the growth and the yield of hemp (Cannabis sativa L.) grown under outdoor environment. The results revealed that hemp grown with coconut coir and soil substrates did not differ substantially in terms of canopy widths and height ($p>0.05$). Fresh inflorescences yield was significantly greater in the soil compared to the coconut coir by 41.37%. Our results suggest that coconut coir can be used as an alternative substrate to grow Cannabis sativa L.

Keywords: Substrate, *Cannabis sativa* L., Outdoor plantation, Coconut coir

1. Introduction

Hemp (*Cannabis sativa* L.) is regarded as a plant that adds economic value and has the potential to boost several enterprises. It is becoming a popular product among environmentally conscious customers. Because every component of the tree, including the leaves, seeds, and bark, may be utilized to manufacture a variety of goods, including those used in the textile industry (Peng & Shahidi, 2021). Additionally, hemp seed oil and extracts are also utilized in food, cosmetics, and health care items because of its excellent nutritional contents such as protein, vitamin E, and omega (McPartland, 2018; Rehman et al., 2021). The cultivation of multifunctional crops, such as industrial hemp, maybe a realistic solution for meeting the increasing demands of human life on our planet. Industrial hemp is an annual herbaceous plant in the Cannabinaceae family that is produced primarily for industrial usage. It is one of the most rapidly growing plants (Rehman et al., 2021).

However, the genotypes and growing technique must be carefully chosen to achieve optimal flower output and quality (Burgel et al., 2020). Evans and Gachukia (2004) suggested that choosing the right substrate components is crucial for delivering the physical and chemical attributes that a particular plant species requires, as well as the optimal growth circumstances. The most alternative substrate for hemp is peat. However, peat providers face increasing sod prices, which, along with increased public concern over peat collection for horticulture reasons, necessitates expertise and understanding of alternative combinations and their ability to substitute peat (Burgel et al., 2020). Therefore, in this study, we aim to use coconut coir as an alternative substrate.

Coconut coir, an environmentally benign material with stable physicochemical and biological qualities, is rapidly being employed as a growing substrate in horticulture production (Barrett et al., 2016). Coconut coir is coconut waste made up of dust and short fibers, and approximately 12 million tons are generated worldwide each year (Mariotti et al., 2020; Nitish et al., 2021). This material offers a favorable air-water balance and has a higher re-wetting capability than peat (Blok & Wever, 2005). However, coconut coir has a higher pH and poorer cation exchange capacity than peat (Landis, 2011). Coconut coir must be treated to decrease dangerous quantities of sodium and potassium (Poulter, 2011). The objective of this study was to investigate the effects of coconut coir on the plant development and production yield of hemp in comparison to soil culture in outdoor plantations.

2. Research Methodology

2.1 Experimental Site and Crop Planting

The experiment was conducted in the outdoor plantations at Rong Wua Daeng, San Kamphang, Chiang Mai, Thailand (Latitude 18.7460511,99, Longitude 0459456,12) from 10 September 2023 to 26 January 2024. The average temperature ranged from 16.0 to 35.0°C.

The hemp cloning (Charlotte's Angel cultivar) was transplanted to substrate cubes for 45 days. After planting on the substrate cube, hemp crops were transplanted to substrate 10 L bucket, as presented in Figure 1.

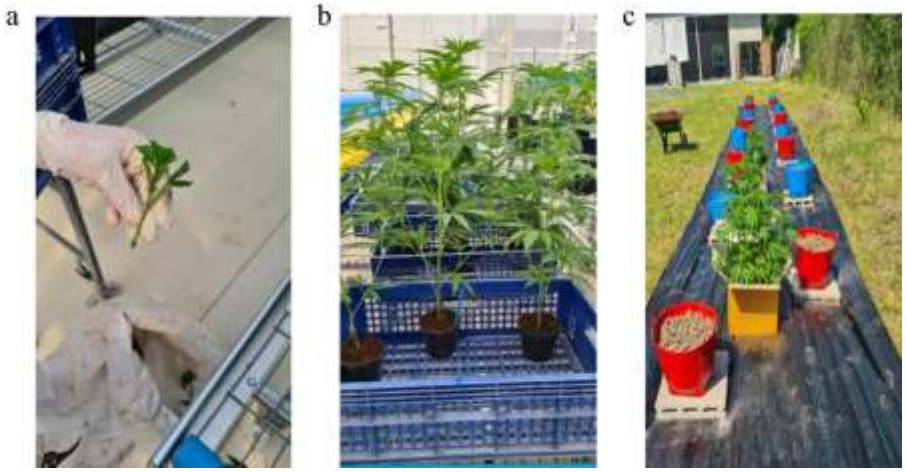

Fig. 1 - (a) hemp cloning; (b) 45 days of cloning; and (c) bucket with experimental substrates.

2.2 Experimental Design

The following substrates including coconut coir and soil culture were used as cultivation substrates in the experiment. Coconut coir and soil substrates were bought from Kamthieng Market in Chiang Mai, Thailand. The substrates were put into the 2/3 bucket, as showed in Figure 2. The experiment was a completely randomized design with ten replicates and each replicate contained one cultivation plant.

Fig. 2 - (a) soil substrate; (b) coconut coir substrate.

2.3 Data Collection

The canopy widths and height were measured weekly from the end of October until January. Inflorescences and hemp weight were harvested from 20 crops to measure the individual fresh yield of inflorescences. Individual weight was measured using electronic balance.

2.4 Statistical Analysis

Data were subjected to an independent t-test using SPSS 18.0 software (SPSS statistical package, Chicago, IL, United States). The statistical significance of the results was analysed at the 0.05 level.

3. Results and Discussions

3.1 Canopy widths and height during cultivation

The canopy widths in both soil and coconut coir substrates increased gradually during the first 6-week period after transplanting and were then maintained at relatively stable levels during the next 16 weeks (Figure 3). In general, the growth of canopy widths was lower in coconut coir than in soil substrate during the week 9 to 13. However, no significant difference was found in the canopy widths among different substrate cultivations (Table 1).

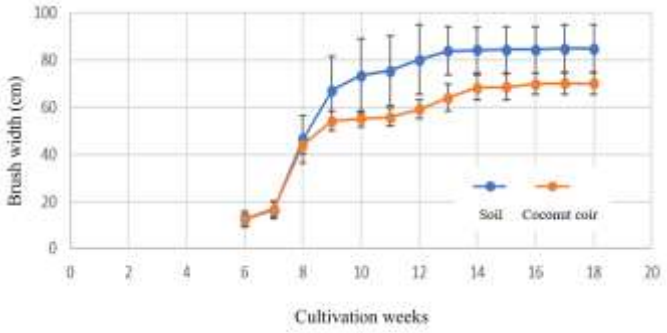

Fig. 3 – The growth of canopy widths during cultivation in the soil and coconut coir substrates.

Table 1 - The average of canopy widths between soil and coconut coir substrates.

Substrate	**Canopy widths)cm(ns**
Soil	84.88±10.21
Coconut coir	70.12±4.76

ns means not significant difference)p>0.05).

Data on plant height indicated that the height of hemp cultivated in soil was significantly greater compared to plants grown in coconut coir, during vegetative growth at weeks 9. At the end of generative growth at weeks 18, hemp cultivated in soil was taller at 105.00±0.09 cm, whereas coconut coir substrate (85.87±0.17 cm) showed significant shorter plants (Figure 4; Table 2). Final height was not affected by different substrates. The reduced growth rate observed in hemp grown in coconut coir could be due to the lower cation exchange capacity than in soil, which reduces nutrients availability for vegetative stage (Landis, 2011). Calcium is well recognized to have an important part in the development of plant tissues, allowing them to grow more efficiently. Perhaps the high calcium concentration of soil, as opposed to coconut coir, had a substantial impact on plant height variation (Tuckeldoe et al., 2023).

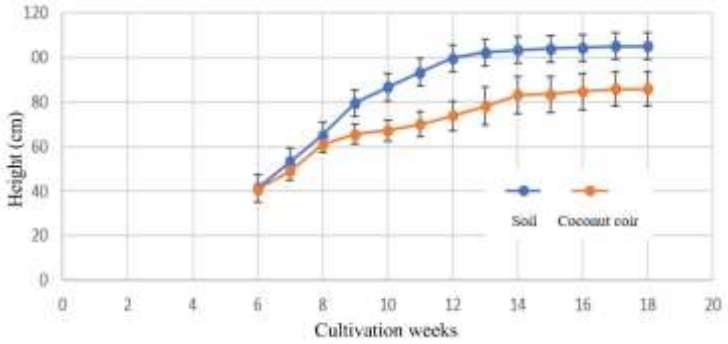

Fig. 4 - The growth of plant height during cultivation in the soil and coconut coir substrates.

Table 2 - The average of hemp height between soil and coconut coir substrates.

Substrate	Hemp height)cm([ns]
Soil	105.00±0.09
Coconut coir	85.87±0.17

ns means not significant difference)p>0.05).

3.2 Effect of substrate on fresh inflorescences yield

Fresh inflorescences yield showed significant differences ($p < 0.05$) among groups from different substrate, as showed in Table 3. Between the two substrate types, soil culture was the highest (424.11±93.24 g) of fresh inflorescences yield by 41.37%. The use of coconut coir as substrate indicated a reduction of hemp height and fresh inflorescences yield, which was consistency with the work of Burgel et al. (2020) who found coco coir fibres, standard peat-based media and peat substituted with 30% of green fibres, had significant impacts on the growth, biomass yields, root development and nitrogen tissue content of *C. sativa* after harvest.

Table 3 - The average of inflorescences yields between soil and coconut coir substrates.

Substrate	Inflorescence's yield)g(
Soil	424.11±93.24[a]
Coconut coir	300.00±100.21[b]

Different uppercase letters in the same column indicate the significant difference among the substrates ($p< 0.05$).

4. Conclusions

The results of this study showed that different substrate namely soil and coconut coir had no significant impacts hemp growths. The use of coconut coir as the substrate showed a reduction of inflorescences yields. However, a more detailed evaluation of the response of hemp growth produced with coconut coir to water stress and elements is needed. The outcome of this study has shown that coconut coir has a potential to be utilized as a reliable substrate for hemp commercial production under outdoor plantations. In addition, this research has provided useful evidence to farmers.

Acknowledgements

We thank the Payap University for administrative and technical support.

References

Barrett, G., Alexander, P., Robinson, J., & Bragg, N. (2016). Achieving environmentally sustainable growing media for soilless plant cultivation systems–A review. Scientia horticulturae, 212, 220-234.

Blok, C., & Wever, G. (2005). Experience with selected physical methods to characterize the suitability of growing media for plant growth. International Symposium on Growing Media 779,

Burgel, L., Hartung, J., & Graeff-Hönninger, S. (2020). Impact of different growing substrates on growth, yield and cannabinoid content of two Cannabis sativa L. genotypes in a pot culture. Horticulturae, 6(4), 62.

Evans, M. R., & Gachukia, M. (2004). Fresh parboiled rice hulls serve as an alternative to perlite in greenhouse crop substrates. HortScience, 39(2), 232-235.

Landis, T. D. (2011). The target plant concept-a history and brief overview. Riley LE, Haase DL, Pinto JR (tech coords) National Proc: Forest and Conservation Nursery Assoc—2010. Proc RMRS-P-65. US Dept Agric Forest Serv Rocky Mtn Res Sta, Ft Collins, CO, 61-66.

Mariotti, B., Martini, S., Raddi, S., Tani, A., Jacobs, D. F., Oliet, J. A., & Maltoni, A. (2020). Coconut coir as a sustainable nursery growing media for seedling production of the ecologically diverse Quercus species. Forests, 11(5), 522.

McPartland, J. M. (2018). Cannabis systematics at the levels of family, genus, and species. Cannabis and cannabinoid research, 3(1), 203-212.

Nitish, S., Sangita, D., Ramya, A., & Kumar, G. S. (2021). Comparative Study on Soil Stabilization using Industrial by Products and Coconut Coir. Journal of Physics: Conference Series,

Peng, H., & Shahidi, F. (2021). Cannabis and cannabis edibles: a review. Journal of agricultural and food chemistry, 69(6), 1751-1774.

Poulter, R. (2011). Quantifying differences between treated and untreated coir substrate. I International Symposium on Organic Matter Management and Compost Use in Horticulture 1018,

Rehman, M., Fahad, S., Du, G., Cheng, X., Yang, Y., Tang, K., Liu, L., Liu, F.-H., & Deng, G. (2021). Evaluation of hemp (Cannabis sativa L.) as an industrial crop: A review. Environmental Science and Pollution Research, 28(38), 52832-52843.

Tuckeldoe, R. B., Maluleke, M. K., & Adriaanse, P. (2023). The effect of coconut coir substrate on the yield and nutritional quality of sweet peppers (Capsicum annuum) varieties. Scientific reports, 13(1), 2742.