Effect of palmyrah coir dust on physicochemical properties of potting media and on growth and yield of chilli

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Introduction

Palmyrah (*Borassus flabellifer*) coir dust is a major by-product of the fibre industry. Coir waste or coir pith is generally a mixture of dust, bits and fibres of shortlength that is rejected during the process of coir extraction. Coir dust is a spongy material which can absorb ample quantity of water compared to its weight and it is a valuable carbon source which could be used in agriculture to maintain and improve the organic matter content of depleted soils(Vidhana Arachchi and Somasin, 1997). Organic matter can improve the soil properties in long run (Kularathne *et al*., 2005).Although Palmyrah coir dust is a very useful carbon source for agriculture, it is wasted by burning at the factory. No studies have been undertaken to investigate the beneficial effects of palmyrah coir dust which can be used in agriculture. This research was conducted to study the effect of palmyrah coir dust on physicochemical properties of potting media and on growth & yield of capsicum.

Methodology

A pot experiment was carried out at Palmyrah Research Institute, Jaffna under greenhouse conditions(temperature 30.1 $C^{o}$and relative humidity 80.9 % during day time). Six treatments were used: T1:-control (soil alone), T2:- palmyrah coir dust: soil (1:1), T3:- palmyrah coir dust: soil (1:3), T4:-palmyrah coir dust: soil: sand (2:1:1), T5:- palmyrah coir dust: soil: sand (1:2:1), T6:- palmyrah coir dust: soil: sand (1:1:2). The experiment was laid in a Complete Randomized Design (CRD) with three replicates. Hungarian Yellow Wax variety was selected as the test crop considering its short harvesting period.Potting media were prepared by mixing palmyrah coir dust, soil and sand in a different ratio on weight basis according to the treatments. All agronomic practices were undertaken according to the guidelines provided by the Department of Agriculture (DAO, 2006). Plant height (cm), crop yield (g), bulk density (g/cm^{3}), porosity (%), water retention (% wt), pH, electrical conductivity (µs/cm), cation exchange capacity (meq/100g), available nitrogen (%), available phosphorus (%), organic carbon (%), exchangeable calcium (%) and exchangeable magnesium (%) were measured. Data was analyzed using SAS software package and the mean separation was done by Least Significant Difference (LSD) at p=0.05 probability level.

Results and Discussion

Significantly, the highest bulk density (1.41 ± 0.05 g/cm^{3}) was recorded in the control treatment (T1). As given in Table 1, the lowest porosity (88.63 ± 0.05 %) and the lowest water retention (33.64 ± 0.05 %) were recorded in control treatment (T1). The highest porosity (95.75 ± 0.05 %) and the highest water retention (153.26 ± 0.05 %) were recorded in T4 treatment (palmyrah coir dust: soil: sand 2:1:1) followed by T5 treatment and T3 treatment at 5 % probability level.

Palmyrah coir dust is a light weight material with low bulk density (0.128 g/cm ^{3}).Incorporation of palmyrah coir dust increased the porosity and water retention of potting media and reduced the bulk density.

Table 01. Effect of different treatment on physical properties of potting media

Physical properties	Treatments					
	T1	T2	T3	T4	T5	T6
Bulk density (g/cm ^{3})	1.41^a	0.43^c	1.18^b	0.44^c	0.43^c	0.18^d
Porosity (%)	88.63^e	92.13^c	90.17^d	95.75^a	92.72^c	94.57^b
Water retention (%)	33.64^f	83.96^d	101.12^c	153.26^a	135.70^b	70.97^e

*Different superscripts along the columns are significantly difference at p = 0.05.

As given in Table 2, there was no significant difference in pH among the treatment. The highest EC (2240.0 ± 0.05 µs/cm), CEC (20.266 ± 0.05 meq/100g) and organic C (3.806 ± 0.05 %) were recorded in T2 treatment. The highest available P (0.306 ± 0.05 %) was recorded in T4 treatment. There was no significant difference in available P between T4 and T2. The lowest EC (119.9 ± 0.05 µs/cm), available P (0.03 ± 0.05 %) and organic C (0.352 ± 0.05 %) were recorded in control treatment (T1). Significantly, the highest available N (0.089 ± 0.05 %) and exchangeable Ca (3.60 ± 0.05 %) were recorded in control treatment (T1) at 5 % probability level. The highest exchangeable Mg (3.613 ± 0.05 %) was recorded in T4 treatment (palmyrah coir dust: soil: sand 2:1:1) and the lowest exchangeable Mg (0.156 ± 0.05 %) was recorded in control treatment (T1). Chemical properties of coir dust, soil and sand vary depending on origin, structural composition and mineral composition. Palmyrahcoir dust has higher CEC value (96.6meq / 100g) and application of coir dust helps to increase CEC of potting media. Palmyrah coir dust is a carbon rich (57.3%) material and characterized with high C: N ratio. Soil taken for the study is calcic red yellow latosol type and it has higher calcium content because of limestone layer below the soil profile in that area. Palmyrah coir dust increased EC, CEC, available P, organic C and exchangeable Mg and reduced exchangeable Ca of potting media when incorporate with soil and sand without change the pH.

Table 02. Effect of different treatments on chemical properties of potting media

Chemical properties	Treatments					
	T1	T2	T3	T4	T5	T6
pH	6.82^a	6.63^a	6.74^a	6.62^a	6.61^a	6.74^a
EC (µs/cm)	119.9^e	2240.0^a	902.7^{cd}	1742.0^b	1022.6^c	782.7^d
CEC (meq/100g)	8.466^e	20.266^a	10.334^c	9.559^d	17.400^b	6.876^f
Available N (%)	0.089^a	0.0813^b	0.080^b	0.059^d	0.068^c	0.054^d
Available P (%)	0.030^d	0.264^a	0.143^c	0.306^a	0.183^{bc}	0.190^b
Organic C (%)	0.352^e	3.806^a	2.858^c	3.306^b	2.145^d	2.048^d
Exchangeable Ca (%)	3.60^a	3.09^c	3.516^b	1.443^f	2.936^d	1.803^e
Exchangeable Mg (%)	0.156^f	2.736^b	1.283^d	3.613^a	1.540^c	0.996^e

*Different superscripts along the columns are significantly difference at p = 0.05.

Significantly, the highest plant height (29.46 ± 0.05 cm) and crop yield (132.41 ± 0.05 g) were recorded in T5 treatment followed by T4 and T3 at 5 % of probability level (Table 3).Soil organic matter of which carbon is a major part holds a great proportion of nutrients, cations and trace elements that are importance to plant growth. It prevents nutrient leaching and is integral to the organic acids that make minerals available to plants. T2 treatment had higher organic carbon content hence nitrogen immobilization may occur which leads to reduce the availability of nitrogen and consequently adversely affect the plant growth and yield. In T5 treatment the level

of organic carbon may be optimum hence nutrient availability will increase during time period due to optimum microbial activity which improved crop growth and yield. Variation in chemical and physical properties of the medium and differences in plant sensitivity to a defined root environmental condition might have contributed to the marked differences in plant development. Therefore, the properties of the growing medium affect the plant growth and yield.

Table 03. Effect of different treatment on growth and yield of capsicum

Growth and yield parameters	Treatments T1	T2	T3	T4	T5	T6
Plant height (cm)	14.43^{d}	14.80^{d}	21.20^{c}	24.53^{b}	29.46^{a}	19.40^{c}
Crop yield (g)	80.53^{c}	49.11^{d}	100.96^{b}	109.56^{b}	132.41^{a}	86.059^{c}

*Different superscripts along the columns are significantly difference at p = 0.05.

Conclusions

Incorporation of palmyrah coir dust increased the physical and chemical properties of potting media when mixed with soil and sand. Palmyrah coir dust improved growth and yield parameters of *Capsicum annum* when compared to soil. Palmyrah coir dust with soil and sand (1:2:1) medium was the best medium followed by medium including palmyrah coir dust with soil and sand (2:1:1) and palmyrah coir dust with soil (1:3).

References

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