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Challenges in Biochemical Engineering and Biotechnology for Sustainable Environment

Studies on the Moisture Retention Capacity of Coir Pith, as a Function of Time

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Abstract: Coir pith is an agro-pollutant generated during the extraction of coir fibre from coconut husks. It causes air, water and soil pollution and is considered as an environmental nuisance. The only advantageous property of coir pith is its moisture holding capacity. The held water in the inner matrices of coir pith has to be retained for a long period of time if the coir pith is being used as a potting medium. In this context, the water retention capacity of coir pith was studied as a function of time. This study was carried out in the different grades of coir pith. The results will be discussed in detail.
Key words: agro-pollutant, matrices, grades, conservant, mounds.

Introduction

Coir pith or coir dust is a major waste product of coir fiber extracting industries[1-2]. The estimated annual production of coir pith in coir industries of India is about 7.5 million tons[3-4]. The elastic cellular cork like pithy material forming the non-fibrous tissue of the husk is generally referred to as the coir pith, which accounts for 50-60% of the total weight of the husk[5]. Among the agro-industrial solid wastes, coir pith has created several disorders to human beings directly and indirectly. It also offers an ideal breeding base for rodents and insect pests. During rainy season, the tannins and phenols of the coir pith are leached out into the soil and into the irrigation canals, thereby making agricultural lands unproductive. Moreover, the water pollution caused by such leaching is harmful to the aquatic and soil biological life[6].

Furthermore coir pith does not carry any direct commercial value and the only advantageous property of this material is its high water holding capacity which enables it to serve as moisture conservant due to the high moisture absorptivity[7]. It is a highly lignocellulosic waste dumped in huge piles on roadside. Because of its high lignin content and slow degradation in the natural environment, it creates environmental pollution[8]. Hillocks of coir pith accumulate in the vicinity of coir-fiber extraction units, of which disposal and management remain a major problem[9]. Moisture retention is the function of water holding capacity. Such water holding capacity is usually higher in smaller particles and ultimately its influence on the water retentivity of the different grades of coir pith remains to be investigated. The present study was initiated to study the moisture retentivity of different grades of coir pith as a function of time.

Materials and Methods

Collection of coir pith

The coir pith required for the present investigation was collected from the coir industries of Cuddalore district, located 1km away from Cuddalore Town, Tamil Nadu, India and 50kms away from the University Campus. After the extraction of coir fibre, the generated coir pith was dumped in huge mounds alongside the industrial sites. The coir pith required for the present study was collected from fresh mounds. While collecting coir pith from the mounds, the surface layer of the mound to a depth of 15cms was scrapped and discarded and the inner fresh layer was collected. The collected coir pith was stored in gunny bags and transported to the laboratory immediately for further studies.

Table 1: Groups of coir pith containing specific ranges of particle size and their respective mean

Group No.	Range of particle size (micron)	Mean size of the particle (micron)
1	0 to 250	125
2	250 to 500	375
3	500 to 850	675
4	>850	850

Grading of coir pith

As soon as the coir pith samples were brought to the laboratory, a portion of coir pith was sun dried for 3 to 4 days so as to remove moisture for chemical analysis and the remaining was kept afresh to facilitate the determination of physical characteristics. Extraneous materials if any like stones, pebbles, dusts, fibres, etc., were removed from the coir pith manually. The coir pith was then passed through a series of sieves of different mesh size so as to segregate them into different groups based on the size of the particles for the various analysis. The sieves used were as follows:

1. 250 micron (0.25 mm)- A.S.T.M 60
2. 500 micron (0. 5 mm)- A.S.T.M 35
3. 850 micron (0.85 mm)- A.S.T.M 20

Dried coir pith was well-mixed and passed through 250 micron sieve. The coir pith mass, retained below the sieve, was separated, packed and labeled as 0 to 250 micron particles. The left over coir pith mass was then passed through 500 micron sieve. The retained mass below the sieve was separated and labeled as 251 to 500 micron particles. The left over coir pith was again passed through 850 micron sieve. The retained mass below the sieve was labeled as 501 to 850 microns and the mass retained above the sieve was labeled as >850 micron particles. The various grades of sieved coir pith were subjected for moisture retention studies. It was determined by the method of Ross[10].

Results and Discussion

Table 2: Moisture retentivity of coir pith as a function of time (%) (Mean ± SD) (six replicates)

Time	250µm	500µm	850µm	>850µm
Initial day	559.75 ± 1.52*	573.50 ± 2.31*	559.40 ± 2.07	572.70 ± 2.46
I day	387.15 ± 9.59*	375.70 ± 3.02*	259.80 ± 1.32	259.90 ± 3.86
II day	262.95 ± 4.05*	241.65 ± 6.33*	149.10 ± 2.59	153.90 ± 4.03*
III day	190.85 ± 1.02*	171.65 ± 1.85*	111.10 ± 1.96*	115.30 ± 1.90
IV day	123.80 ± 2.22	114.00 ± 2.73	104.90 ± 2.02*	106.60 ± 0.87*
V day	113.85 ± 1.07	104.55 ± 1.21*	101.60 ± 1.65*	102.40 ± 1.47*
VI day	98.90 ± 1.24*	99.55 ± 0.62*	98.80 ± 1.38*	100.80 ± 0.82*
VII day	96.30 ± 0.96*	97.00 ± 1.07*	97.90 ± 0.76*	99.90 ± 1.24*
VIII day	95.30 ± 1.19	95.45 ± 0.40	97.60 ± 1.01*	99.00 ± 1.13*
IX day	94.75 ± 0.86*	95.05 ± 0.43*	96.80 ± 0.63*	98.60 ± 0.77*
X day	94.40 ± 1.01*	95.05 ± 0.90*	96.40 ± 1.08*	98.60 ± 1.09*

* The mean difference is significant at the 0.05 level

The moisture retentivity was determined in raw coir pith in consecutive days as a function of time. The percentage of moisture retentivity was decreasing in all particles as the days advanced. Highest percentage of moisture retentivity was observed in the 500 micron particles and the lowest in 850 micron particles. The percentage retentivity observed during the first day in >800 micron size decreased significantly after ten days of observation i.e. from 572.70 ± 2.46 to 98.60 ± 1.09. The lowest percentage of moisture retentivity after ten days was recorded in 250 micron particles i.e. 559.75 ± 1.52 to 94.40 ± 1.01. When the retentivity was compared in the other two groups, the lowest percentage of retentivity was observed in smaller particles and the highest retentivity in bigger particles (Table 2).

The moisture retentivity had significantly decreased in all the grades as a function of time. The smaller particles had heavily retained the moisture for a prolonged period of time and larger particles had lowest capacity of moisture rententivity. Because the micro pores might have acted as a key in retaining the moisture in smaller particles and macro pores easily eliminated the water molecules to the environment and acted as an eliminator in the larger particles. Sharma and De Datta[11] stated that, water retention capacity primarily depends on the number, size and distribution of pores and the specific surface area of the medium. Jeyaseeli and Paul Raj[12] stated that the water absorptivity was low in larger particles and high in smaller particles due to the nature, size and distribution of the pores that determined the moisture retentivity. Hence it could be well evident that the pores play a very significant role in retaining the moisture in the coir pith grades.

Conclusion

Growing medium is the most important element in green house crops production, nurseries and horticulture which call for a number of enriching inputs. Absence of physical properties like aeration, drainage and water holding capacity makes soil unsuitable for the production of plants in containers. To improve this situation several soilless growing media have been developed. One such media is the coir pith, a multi purpose growing medium that provides new opportunities for potting mix suppliers, seedling nursery operators, hydroponic growers, home gardens, green houses and other farming communities. Coir pith posses a greater advantage of allowing good aeration around the roots of plants grown over it and has the unique property of retaining water for longer duration of time. This property of the coir pith may facilitate the continuous and prolonged availability of water for the plants grown at large and may thus act as an ideal potting medium.

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