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K Kalaivani
Department of Floriculture and Landscaping, Horticulture College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

M Jawaharlal
Department of Floriculture and Landscaping, Horticulture College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Correspondence
M Jawaharlal
Department of Floriculture and Landscaping, Horticulture College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Studies on chemical properties of Cocopeat with different proportions of organic amendments for soilless cultivation

K Kalaivani and M Jawaharlal

Abstract
The present study was conducted to assess the chemical properties of the selected media such as pH, EC, N, P, K, Ca, Mg, Fe, Mn, Zn, Cu of six different media comprising of (w/w) Cocopeat (T_1), Cocopeat + Vermicompost (5:1) (T_2), Cocopeat+ Biocompost (5:1) (T_3), Cocopeat + Pressmud (5:1) (T_4), Cocopeat + Vermicompost + Biocompost (5:1:1) (T_5), Cocopeat + Vermicompost + Pressmud (5:1:1) (T_6) were determined. The findings revealed that all media combinations except Cocopeat (T_1) contains increased amount of plant essential nutrients. The maximum macro and micro nutrient elements contents were found in Cocopeat+ Vermicompost + Biocompost (5:1:1) (T_5) followed by Cocopeat+ Vermicompost + Pressmud (5:1:1) (T_5) and minimum macro and micro elements were registered in Cocopeat (T_1). It was observed that all the media were found to be suited for soilless production based on the plant sensitivity to low, medium and high level of soluble salts present in the media and also based on crop specific nutrient requirement. Hence, the study reveals that Cocopeat with different proportions of organic amendments can reduce the cost of inorganic fertilizers and inturn cut down overall production cost.

Keywords: Chemical properties, Cocopeat, organic amendments, soilless cultivation

Introduction
In horticultural crop production, the defined soilless cultivation encompasses all the systems that provide plant management in soilless conditions in which the supply of water and of minerals is carried out by nutrient solution, with or without a growing medium (e.g. rockwool, peat, perlite, pumice, coconut fibre, etc.) (Winsor and Schwarz, 1990) [10]. The physical and chemical properties of the media greatly affect the growth of the plants. Hence, it is very important to select the proper medium for the production of high quality plants. A by-product of processing coconut husks is known as coir dust, cocopeat, coir pith or simply coir. Coir is a versatile natural fiber extracted from mesocarp tissue, or husk of the coconut. The husk contains 20% to 30% fiber of varying length and holds 8-9 times its weight in water. It can be reused for up to 4 years (Preethi *et al.*, 2018). A growing medium material, such as peat, that naturally possesses a similar pH range, will provide a relatively optimal availability of nutrients. In contrast, composted materials, may contain high levels of soluble salts which are complicated and expensive to remedy (Rainbow and Wilson, 1998) [10].

Table 1: Chemical properties of individual media component

Media components	pH	EC	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	Fe (ppm)	Zn (ppm)	Mn (ppm)	Cu (ppm)
Cocopeat	6.10	0.63	0.41	0.81	1.32	0.21	0.31	23.00	22.00	17.00	5.00
Vermicompost	6.80	0.71	1.25	1.14	1.19	0.43	0.40	102.00	59.00	28.00	2.50
Pressmud	6.70	1.80	2.25	1.91	3.80	2.60	2.50	845.00	662.00	140.00	15.00
Biocompost	5.10	6.97	1.98	1.78	4.20	2.80	2.80	1074.00	1023.00	189.00	47.00

Vermicompost is the end product of the breakdown of organic matter by the earthworm. It is an odourless organic material containing adequate quantities of N, P, K and several micronutrients essential for plant growth (Preethi *et al.*, 2018).
Pressmud is generated as a by-product of sugarcane industries and characterized as a soft, spongy, amorphous, and dark brown to brownish material (Ghulam *et al.* 2012) [2]. It is generated during the purification of sugar by carbonation or sulphitation process. It is rich in essential plant nutrients which can be an alternate source of inorganic fertilizer. In general, when 100 tonnes of sugarcane is crushed, about 3 tonnes of pressmud are produced as a

by-product (Gupta *et al.* 2011) [3]. The raw spentwash generated after fermentation and distillation process is acidic in nature, having dark brown color with unpleasant odour, high COD, and BOD (1,00,000 and 45,000 mg L-1) and EC. Treated Spent wash, press mud, and other agro-based industrial bio-resources can be bio-composted into nutrient rich organic products, which can serve as a good nutrient amendment for soilless cultivation (Kulkarni *et al.* 1987) [6]. Hence the present study involves the physio-chemical characterization of Cocopeatwith different proportion of Vermicompost, pressmud and biocompost suitable for soilless production system under protected systems.

Materials and Methods

The different organic amendment combinations comprising of (w/w) Cocopeat (T_1), Cocopeat + Vermicompost (5:1) (T_2), Cocopeat+ Biocompost (5:1) (T_3), Cocopeat + Pressmud (5:1) (T_4), Cocopeat + Vermicompost + Biocompost (5:1:1) (T_5), Cocopeat + Vermicompost + Pressmud (5:1:1) (T_6) for soilless cultivation. The study was carried out at Department of Floriculture and Landscaping, Tamil Nadu Agricultural University, Coimbatore. The initial chemical characters of individual media components were analysed and given in the Table 1.

Composting

The composting of different combinations of Cocopeat and organic wastes were done in piles (1.5 m high, 3 m width and 80 m long). Periodical turning of piles in weekly intervals facilitate O_2 levels inside the pile. Moisture content should be maintained not less than 50 per cent. At the end of the 45 days, the samples were collected for analyzing the chemical and physical properties. Each sample was made by mixing five sub samples taken from five points in the pile and then subjected to analysis.

pH and EC

The pH values for all media before and after planting were determined by mixing 10 g of media with 50 ml distilled water, agitated for 30 minutes and left standing for 24 hrs. For determination of EC, 40 g of media was mixed with 80 ml distilled water, shaken for 15 min and left for 60 min. The mixtures were filtered before the measurements were made using a pH meter and EC meter.

Nutrient analysis:

Total Nitrogen was determined by Kjeldahl digestion (Humphries, 1956) [4], Total Phosphorous by Vanado molybdate phosphate yellow colour method (Jackson, 1973) [5] and the potassium content was estimated by Flame photometer (Jackson, 1973) [5]. Total Ca and Mg was estimated by EDTA titration method (Derderian, 1961). Micronutrients (Cu, Fe, Zn, Mn) by Atomic Absorption Spectrophotometer (Make: Varian Techron, Model-Spectrometer AA 10/20 BQ for micronutrient analysis).

Statistical Analysis

The experiment was conducted in Completely Randomised Design (CRD). The data obtained was compared according to the method suggested by Snedecor and Cochran (1989).

Results and Discussion

The results of pH and EC status of different media are presented in Table.2. The maximum pH (6.30) was recorded in Cocopeat + Vermicompost (5:1) (T_5) combination while the minimum value for pH (5.60) was registered in the combinations of Cocopeat + Biocompost (5:1) (T_5). The EC level was maximum (4.50) in Cocopeat + Biocompost (5:1) (T_5) and minimum value for EC (0.62) was recorded in Cocopeat (T_1). The analytical results indicated that all the media registered optimum range of pH between 5.2 to 6.4 for soilless production. But the EC value was very high (4.5) and (4.3) in case of Cocopeat + Biocompost (5:1) and Cocopeat + Vermicompost + Biocompost (5:1:1). In soilless media, amount of soluble salts play a major role in determining the plant nutrient uptake. Hence, both the media combinations (T_3) and (T_5) are found to be not suitable for salt sensitive plants unless the salts are leached to the optimum level

Table 2: pH and EC of different soilless media

Treatments	pH	EC
T_1	6.20	0.62
T_2	6.30	0.68
T_3	5.60	4.50
T_4	6.10	0.90
T_5	5.90	4.30
T_6	6.20	0.92
Mean	6.05	1.99
S.Ed	0.28	0.14
CD (p=0.05)	0.57	0.28

The results of macro nutrients (N,P,K,Ca,Mg) of different media are presented in Table.3. The results revealed that the Cocopeat+ Vermicompost + Biocompost (5:1:1) (T_5) combination recorded the maximum K (3.55%), Ca (2.40%) and Mg (2.35%). Cocopeat + Vermicompost + Pressmud (5:1:1) (T_6) recorded the maximum N (2.12%), P (1.56%). Cocopeat (T_1) recorded the lowest nutrient values N (0.51%), P (0.89%), K (1.43%), Ca (0.25%) and Mg (0.33%).

Table 3: Macro nutrient content (%) (N, P, K, Ca, Mg) of different soilless media

Treatments	N (%)	P (%)	K (%)	Ca (%)	Mg (%)
T_1	0.51	0.89	1.43	0.25	0.33
T_2	1.61	0.98	1.58	0.34	0.36
T_3	1.78	1.31	3.48	1.42	1.51
T_4	1.87	1.39	3.12	1.34	1.45
T_5	1.98	1.28	3.55	2.40	2.35
T_6	2.12	1.56	3.42	2.25	2.21
Mean	1.65	1.23	2.76	1.33	1.37
S.Ed	0.82	0.06	1.38	0.08	0.08
CD (p=0.05)	0.16	0.12	0.29	0.16	0.16

From Table 4. it was observed that maximum micro nutrients (Cu, Fe, Zn, Mn) in Cocopeat+ Vermicompost + Biocompost (5:1:1) (T_5)*viz.*, Fe (768.78%), Zn (750.43%), Mn (81.33%) and Cu (16.46%) followed by Cocopeat+ Vermicompost + Pressmud (5:1:1) (T_6) *viz.*, Fe (343.31%), Zn (246.00%), Mn (69.42%) and Cu (11.20%) combinations. The lowest micro nutrient content was recorded in Cocopeat (T_1) *viz.*, Fe (24.12%), Zn (24.72%), Mn (17.46%) and Cu (6.18%)

Table 4: Micronutrients (Fe, Zn, Mn, Cu) of different soilless media

Treatments	Fe	Zn	Mn	Cu
T_1	24.12	24.72	17.46	6.18
T_2	56.50	35.39	21.61	6.32
T_3	654.34	668.72	59.30	9.46
T_4	323.65	236.90	44.54	7.73
T_5	768.78	750.43	81.33	16.46
T_6	343.31	246.00	69.42	11.20
Mean	361.78	327.03	48.94	9.56
S.Ed	180.89	163.51	24.47	0.54
CD (p=0.05)	50.60	48.71	5.70	1.08

Since biocompost contains higher level of EC it may not support the salt sensitive plant species to grow. Kulkarni *et al.* (1987) [6] reported that the raw spentwash generated after fermentation and distillation process is acidic in nature, having dark brown color with unpleasant odour, high COD, and BOD (1,00,000 and 45,000 mg l^{-1}) and EC. When this spent wash is not diluted or pre-treated to reduce its high level of soluble salts which also includes sodium, sulphates and chlorides, then the bio compost produced from pressmud along with spent wash will be loaded with too many salts at high level. When it is applied directly to plants may result in phyto-toxicity.

Conclusion

In the present study, selected chemical characteristic of different soilless media found to be suitable for plant growth. Hence, the study reveals that Cocopeat with different proportions of organic amendments which can reduce the cost of inorganic fertilizers and improved the plant growth.

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