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# Use of Coir Pith as a Soil Amendment Material

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**Abstract:** In the present study, an attempt has been made to utilize Coir Pith as a soil amendment material. In this context, laterite soil is taken as the base material and coir pith is added to it externally, with variable ratio to carry out soil fortifications. The major demerit in laterite soil is the presence of nitrogen, phosphorus and potassium, which are not adequate for any proper plant growth. Thus, there is a need of sufficient amount of fertilizers to be utilized to develop the plant growth. In this context, coir pith waste, which is another agricultural waste, dumped in various areas and in long run creates environmental pollution, has been taken as a medium to enhance the nitrogen, phosphorus and potassium content of the soil. The result revealed that by addition of coir pith waste, it is possible to produce a more fertile soil in which there is almost no need of addition of any fertilizer further.

**Key words:** Pollution, potassium, coir pith, amendment.

## Introduction

Coconut cultivation is one of the most vital horticultural crops in our country. This is the only plant which possesses utility in each and every part of it. In coconut productivity India ranks the 3rd position in the world (Ahmed Bavappa, 2003) From coconut about 26% get released as coir fibre which have an appreciable import market. Coir presents an alternative part to synthetic and other fibres. The non-conventional application involves the fabrication of protective coatings on highways and railway embankments, malting etc. For every one ton of fibre, about 2 tons of coir pith is produced (Cardena and Potes, 1971). Taking into account its fluffy nature, its density becomes too low i.e, 0.2 gm/cc and it occupies a large space in the processing centre. Its disposal may relate to fire accidents, various health hazards etc. The tannins released from the heaps of coir pith are highly polluting agents (Chilo, 1974).

Though coir pith consists of various negative parameters, still its organic nature has provided various usable parameters in it. It has a very high water holding property (almost 4 to 6 times of its volume), bulk density, aeration, conductivity and high infiltration rate. Many works have been initiated to utilize this by-product as a soil conditioner (Vietmeyer, 1986) but in terms of use, its practical utility has not been realized so far.

Similarly, the presence of nitrogen, phosphorous and potassium in soil and its importance in performing the soil fertility has been analyzed by several researchers (White et al., 1987). But when any fertilizer in added to it, it reacts in a reverse way which influences directly on the soil dynamics, including physico-chemical properties of the soil (Woodroof, 1970). Thus, in order to decrease or completely stop the use of fertilizer in cultivation, utilization of some agricultural wastes are taken into consideration. Encouraging results were found during the study and it has been found that addition of waste agricultural product i.e. coir pith could enhance the nitrogen, phosphorus and potassium content of the soil.

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## Materials and Method

In the present study, coir pith is obtained from the local coir processing units and the chemical composition is given in Table 1 and the physical properties of the coir pith is represented in Table 2.

Various laboratory experiments were carried out using the above information and the studies were compiled for obtaining better productivity. During experiment, different patches of laterite soils were taken and calculated quantity of coir pith were added to it. The chemical composition of the laterite soil is given in Table 3. Also, the addition of coir pith to laterite soil in various ratios are represented in Table 4.

**Table 1: Chemical composition of raw coir pith**

| *Raw coir pith* | *% Composition* |
|---|---|
| Lignin | 34.00 |
| Cellulose | 27.30 |
| Organic Carbon | 23.70 |
| Nitrogen | 0.38 |
| Phosphorus | 0.009 |
| Potassium | 0.81 |
| Calcium | 0.38 |
| Magnesium | 0.34 |
| Iron | 0.065 |
| Manganese | 0.015 |
| Copper | 0.003 |
| Zinc | 0.008 |

**Table 2: Physical properties of raw coir pith**

| *Raw coir pith* | *Property* |
|---|---|
| Bulk density | 0.2 gm/cc |
| Water holding Capacity | 525% |
| pH | 6.1 |
| C:N ratio | 110.8 |

**Table 3: Chemical composition of the laterite soil**

| *Laterite soil* | *% Composition* |
|---|---|
| $Fe_2O_3$ | 36.6 |
| $SiO_2$ | 20.1 |
| $Al_2O_3$ | 13.2 |
| $Cr_2O_3$ | 6.01 |
| CaO | 6.8 |
| MgO | 5.6 |
| MnO | 0.06 |
| LOI | 1.0 |
| Nitrogen | 0.02-0.05 |
| Phosphorus | 0.02-0.04 |
| Potassium | 0.2-4 |

**Table 4: The addition of coir pith to laterite soil in various ratio**

| *Set No* | *L.S : C.P* |
|---|---|
| S - 1 | 10 : 1 |
| S - 2 | 10 : 2 |
| S - 3 | 10 : 4 |
| S - 4 | 10 : 5 |
| S - 5 | 10 : 10 |

The coir pith added laterite soil is kept neutral for five days and thereafter is mixed mechanically and subjected to analysis. The final coir pith mixed soil is analyzed for NPK value.

## Result and Discussion

The coir pith mixed raw laterite soils are represented in Table 5. The data obtained revealed that with addition of phosphorus, potassium and nitrogen to soil sample through coir pith, NPK concentration has increased drastically in the soil sample.

**Table 5: Enhancement of NPK value of laterite soil due to coir pith addition**

| *% Composition* | *S - 1* | *S - 2* | *S - 3* | *S - 4* | *S - 5* |
|---|---|---|---|---|---|
| $Fe_2O_3$ | 36.8 | 38.1 | 37.3 | 37.8 | 36.5 |
| $SiO_2$ | 20.3 | 19.8 | 21.4 | 19.2 | 20.1 |
| $Al_2O_3$ | 14.8 | 13.6 | 14.1 | 13.2 | 13.5 |
| $Cr_2O_3$ | 5.8 | 6.6 | 6.9 | 5.6 | 6.0 |
| CaO | 6.5 | 7.3 | 7.8 | 6.1 | 6.7 |
| MgO | 4.9 | 4.7 | 5.9 | 6.0 | 5.6 |
| MnO | 0.08 | 0.05 | 0.045 | 0.09 | 0.06 |
| LQI | 1.5 | 2.3 | 1.2 | 1.9 | 1.1 |
| N | 0.31 | 0.28 | 0.35 | 0.21 | 0.34 |
| K | 0.05 | 0.058 | 0.043 | 0.046 | 0.055 |
| P | 0.61 | 0.48 | 0.59 | 0.41 | 0.58 |

Phosphorus, being a major constituent to take part in all activities of plant metabolism, its fortification could enhance the crop production drastically. Interestingly, the phosphorus fortification could increase the organic phosphorus content of the soil, which in turn could serve as a highly fertile medium for valuable crop production.

This parameter is attributed to the fact that coir pith is an organic mass which constitutes the organic elements mostly in terms of phytin, phospholipids etc.

Similarly, potassium in soil sample is classified into three categories: unavailable form, slowly available form and readily available form. Unavailable form constitutes 90-98 percent of total potassium content in the soil which are present in the form of feldspars and micas. The slowly available form are vermiculite, illite etc. which are occasionally available to plants. The readily available form is potassium ($K^+$) present in soil solution and gets absorbed by the plant.

In case of coir pith, potassium content is almost 0.8 to 1.0 percent, which is considered to be very high in comparison to the ordinary soil samples. Thus, potassium fortification can be carried out successfully using coir pith as a medium as shown in Figure 1.

In context of nitrogen, it is constituted as metabolically active compounds such as amino acids, proteins, enzyme etc. It regulates the growth factor in plants. It is generally present in two forms: elemental form and combined form. The combined form consists of both organic and inorganic forms. The general nitrogen content of the soil is 0.02-0.4 percent. In general processes such as crop removal, leaching along with acidified water, liberatira in gaseous form, soil erosion etc. include loss of nitrogen with the present climatic condition and anthropogenic activities. There is a gradual loss in soil nitrogen content. Addition of coir pith to fly ash can enhance the organic nitrogen content of the ash. Thus, coir pith addition can serve as a good source of fortification to soil for enhancing organic nitrogen content as shown in Figure 2.

The result revealed that when coir pith is added to laterite soil at variable ratio soil can be fortified in NPK concentration. As various ratios of coir pith and laterite additions are taken into consideration and when the addition is carried out at a ratio 10 : 4 i.e. latrite soil to coir pith ratio, a maximum of seven times of organic nitrogen from the laterite nitrogen content, is getting fortified in the soil. Similarly, when we take phosphorus into consideration a ratio of 10 : 1 i.e. caterite soil to coir pith is found to have phosphorus fortification about 15 times more than the laterite sample as shown in Figure 3.

The data also shows that when laterite soil to coir pith ratio is taken in the range of 10 : 1 (L.S : C.P) maximum phosphorus fortification takes place whereas with further increase in the ratio there is no appreciable change in the total phosphorus content of the soil.

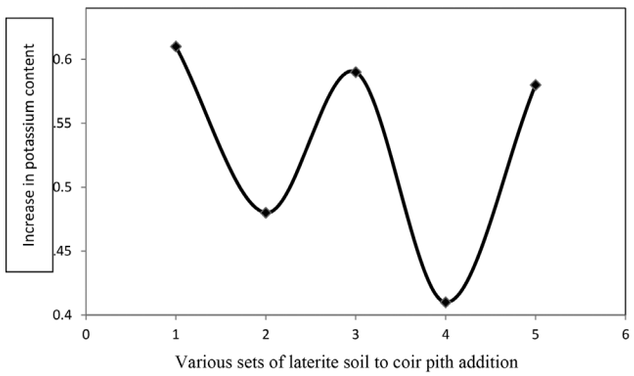


**Figure 1: Enhancement of potassium content in laterite soil.**

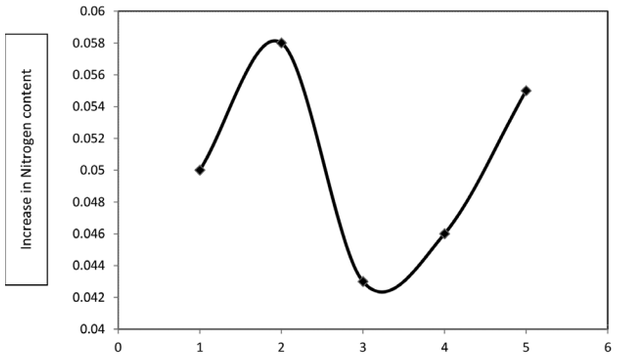


**Figure 2: Enhancement of nitrogen content in laterite soil.**

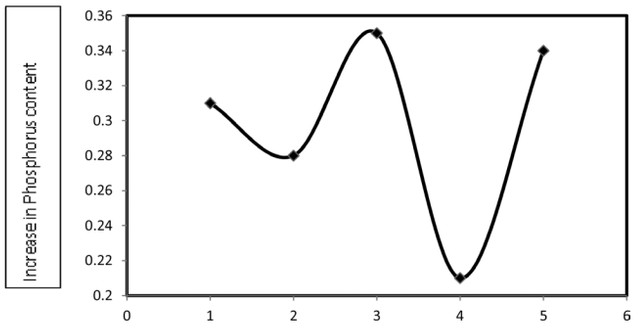


**Figure 3: Enhancement of phosphorus content in laterite soil.**

Similarly, when the ratio is taken as 10:2 (L.S to C.P) it has been observed that there is an appreciable enhancement in potassium content of the soil. Addition of coir pith to laterite soil in the ratio 10 : 3 (L.S to C.P) has enhanced the nitrogen (organic) content of the laterite soil drastically and it has been observed that if coir pith is used about 30% of the soil as a soil amendment material, it could enhance the fertility of the soil in a very high extent.

## Conclusion

The above study revealed that coir pith can act as an organic material for soil amendment. The amended soil thus generated has shown a high NPK conconcentration which can provide an efficient source for cultivation. Thus coir pith as a waste could generate an organic fertilizer which is capable of providing high end productivity.

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