EFFECT OF COIR PITH ON PHYSICO-CHEMICAL AND MOISTURE RETENTION PROPERTIES OF SELECTED SOIL GROUPS OF KERALA

By

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THESIS

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requirement for the degree of

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College of Horticulture

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1995

Dedicated to the loving memory

of my father

DECLARATION

I hereby declare that the thesis entitled "Effect of coir pith on physico-chemical and moisture retention properties of selected soil groups of Kerala" is a bonafide record of work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any other University or Society

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We, the undersigned members of the Advisory Committee of **Sri. R. Venugopal**, a candidate for the degree of Master of Science in Agriculture with major in Soil Science and Agricultural Chemistry, agree that the thesis entitled **"Effect of coir pith on physico-chemical and moisture retention properties of selected soil groups of Kerala"** may be submitted by Sri R Venugopal, in partial fulfilment of the requirement for the degree

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R. VENUGOPAL

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Introduction

INTRODUCTION

Coir industry is an important cottage industry which originated in Kerala and is spreading to other coconut growing states in India The raw material for this industry is coconut husk, the fibrous outer covering of coconut After the extraction of fibre, the coconut husk leaves coir pith as a residue and about two kg of coir pith is yielded by the production of one kg of fibre Coir pith was considered till recently as a pollutant and a problematic waste material of coir industry It has been found that coir pith can be converted into a good soil conditioner ideal for many types of soil Coir pith with its sponge like structure can make itself capable of breaking even the heaviest of clay soils allowing drainage helps to retain water and oxygen and to prevent loosing of vital nutrients

Coir pith decomposes very slowly as its pentosan lignin ratio is below 0 5 which is the minimum required for the slow decomposition of organic matter in the soil It absorbs water more than eight times of its weight and parts with it comparatively slowly It has been found that the incorporation of coir pith at the rate of two per cent W/W in sandy soil can increase the water holding capacity by 40 per cent

However detailed studies on the effect of coir pith on the physico-chemical and moisture retention properties of different soil groups of Kerala have not been investigated At the same time, alternate options for increasing the organic carbon content of inherently poor soils like coastal sandy, laterite and red soils also deserve much attention as farmyard manure and such materials are becoming scarce day by day So the present study was taken up with the following specific objectives

1 To study the effect of coir pith on desirable physical properties of different soil types viz , coastal sandy, laterite and red soils

2 To find out the changes in chemical properties like organic carbon content available nitrogen, available phosphorus available potassium and cation exchange capacity of the soils as influenced by coir pith application

3 To evaluate the moisture retention and release properties of soils treated with different levels of coir pith

Review of Literature

REVIEW OF LITERATURE

1. Moisture retention properties of different soil types

Gupta and Narin (1971) working on the alluvial soils reported that the available moisture capacity of soil could be predicted from the values of silt and clay Thiyagarajan (1978), studying the red and black soils at Coimbatore district reported that the moisture retention properties increased with depth In red soils the moisture held at a tension of 1500 kPa had a very significant linear relationship with clay (r^2 = 0 963)

Prameela (1983) observed that 50 per cent of the available moisture was depleted at a tension just above 100 kPa and at 300 kPa more than 70 per cent of the available water was extracted Thulasidharan (1983) reported that more than 50 per cent depletion of the available water in the sieved soil occurred at less than 300 kPa The mean moisture content of sieved soil at the tensions of 30 and 1500 kPa were 25 2 per cent and 19 4 per cent respectively

2. Relation between soil moisture retention and organic materials

A close relationship of organic matter content with moisture storage capacity, wilting point and available moisture was reported by Loyonet (1977) According to Hollis *et al* (1977) large proportion of the variations in the available water was due to the difference in the organic carbon content Incubation experiments by Mello *et al* (1978) showed that when castor bean meal was added at 20 to 100 tonnes per hectare, water retention capacities of the soils were increased

Riley (1979) studied the relations between easily available water (10 to 100 kPa), strongly held available water (100 to 1500 kPa) and total available water (10 to 1500 kPa) to soil organic matter content The moisture retention characteristics of loamysoils of Cyprus was studied by Orphanos and Stylianov (1980) The field capacity was found to be the highest (33 9% on soil dry weight basis) in the surface layer of 15 cm but was uniform (30 4% to 31 4%) in deeper layers They correlated the higher field capacity values of the surface soil with the higher organic matter content In a similar work on some related tropical soils, Zusevic (1980) found that the permanent wilting percentages of eight light tropical soils from Venezuela were higher in samples with higher organic matter content

Mohsin and Syeedullah (1981) studied the influence of organic carbon on the available moisture of 11 major soil groups of Bihar Organic carbon at permanent wilting point and field capacity were positively correlated According to them the favourable effects of organic carbon on the available moisture was attributed to textural changes because organic carbon increased with fine sand (0 385) and silt (0 194) and decreased with clay (0 397)

In a field experiment conducted in a heavy black soil Mayalagu (1983) observed significant increase in the moisture content of the soil treated with soil amendments like coir pith, farmyard manure and pressmud Nambiar *et al* (1988) studied the effect of blending coconut coir dust with fertilizers on the changes in carbon and nitrogen fractions in a coastal sandy soil of Kerala They observed that the organic carbon content decreased progressively with time of incubation in all the treatments

3. Changes in volume-mass relationships with the addition of organic materials

3 1 Bulk density

Bulk density of soil was found to be decreased by continuous application of farmyard manure and green manure under dry farming situation (Havanagi and Mann, 1970) When the dose of organic manures applied was high, there was a decrease in the bulk density of soil (Biswas *et al* , 1971)

Long term application of farmyard manure in conjunction with chemical fertilizers (over a period of 20 years) resulted in a decrease in bulk density of soil (Prasad and Singh, 1980) A decrease in bulk density was also noticed by the application of lime and farmyard manure in combination with chemical fertilizers, whereas continuous use of chemical fertilizers alone caused an increase in bulk density (Sinha *et al* 1980) In a field experiment conducted in a heavy black soil of Periyar-Vaigai command area of Madurai district (with different soil amendments) Mayalagu (1983) observed that *in situ* bulk density was significantly influenced by different organic soil amendments

A six year field study on the use of organic materials in rice-wheat crop sequence showed that application of farmyard manure and crop residues significantly lowered the bulk density of soil (Sharma *et al* , 1987) Bauer and Black (1992) reported that bulk density decreased with increasing organic carbon concentration The magnitude of change was the greatest in sandy soil and the least in the medium textured soils

3 2 Porosity

Subramanian *et al* (1975) observed an improvement in capillary porosity when red sandy loam soil was treated with organic amendments like maize straw, rice husk, farmyard manure and neem cake Loganathan and Lakshminarasimhan (1979) reported that addition of organic and inorganic amendments increased the porosity of a red sandy loam soil Porosity was improved by combined application of farmyard manure and chemical fertilizers (Mahimairaja *et al* , 1986) Pagliai *et al* (1987) reported that application of poultry manure increased the porosity of a sandy loam soil Loganathan (1990) observed an improvement in total porosity by the application of organic amendments like coir dust farmyard manure and ground nut shell powder in red soil

3 3 Maximum water holding capacity

Loganathan and Lakshminarasimhan (1979) reported that the addition of organic amendments improved the water retentivity of porous and open textured red sandy soil Mayalagu (1983) observed that maximum water holding capacity was significantly influenced when a neavy black soil was treated with organic soil amendments like coir waste pressmud and farmyard manure

4. Changes in the water stable aggregates with the addition of organic materials

Chakraborti (1971) observed that the water stable aggregates were significantly correlated with organic carbon exchangeable calcium CEC, dispersion ratio and suspension percentage but not with clay and free iron oxides

Subramanian *et al* (1975) conducted a study on the effect of organic amendments on the structural properties of a red sandy loam soil An improvement in structural coefficient and stability index was observed due to cropping Yadav and Singh (1976) conducted studies on the soils of Doon Valley in U P and found that large water stable aggregates were positively correlated with organic matter content of the surface soil while the proportion of small aggregates was positively correlated with subsoil clay content

The state of decomposition of organic matter is also known to influence the formation and stability of aggregates Chakrabarti *et al* (1979) reported that small sized aggregates contained higher proportion of humic acid in comparison to large aggregates Loganathan and Lakshminarasimhan (1979) reported that addition of farmyard manure and gypsum had appreciable effect on the stability of soil aggregates Soong (1980) observed that decomposed organic matter had pronounced influence on percentage aggregation and mean weight diameter, while the decomposed form such as particulate matter had little influence

Dinel *et al* (1991) observed that admixing of residual organic overlayers improved the structure of all mineral subsoils, except that of alluvial sands They also reported improved aeration, root proliferation and increase in crop yields due to this treatment Angers (1992) reported that under alfalfa cultivation the mean weight diameter (MWD) of water stable aggregates increased from 1 5-2 3 mm during the five year period This increase in the mean weight diameter was largely attributed to an increase in aggregates of greater than two mm diameter at the expense of the aggregates of 0 25 to 1 0 mm diameter

Rasiah *et al* (1992) studied about the variation of structural stability with water content They observed that wet aggregate stability decreased linearly with increasing water content Clay, organic matter content and pH of the soils explained 80 per cent of the variability in the wet aggregate stability N'dayegamiye and Angers (1993) studied the long term effect of wood residue applications on organic matter characteristics and water stable aggregates They observed that the treatments had no effect on water stable macro aggregation

5. Changes in organic carbon content with the application of organic materials

In the permanent manurial experiment conducted at Pattambi with tall indica rice varieties, it was observed that continuous application of organic matter as cattle manure and green manure resulted in significant improvement in organic carbon content of soil compared to inorganic fertilizers Similar results were obtained for experiments conducted at Pattambi with dwarf indica varieties also and the values varied from 1 19 to 1 93 per cent Contrary to this, continuous application of organic matter for 31 seasons in different forms failed to give any significant increase in organic carbon level in the permanent manurial experiment conducted in sandy soils at Kayamkulam (Kurumthottical, 1982)

Nambiar *et al* (1988) reported that organic carbon content increased upto 52 days after application of farmyard manure in a coarse loamy typic ustochrupt soil irrespective of the levels of application Angers (1992) reported that under alfalfa cultivation the organic carbon content increased within a period of five years in clay soils.

6. Changes in the cation exchange capacity (CEC) with the application of organic materials

Results from the permanent manurial experiment at Pusa showed that CEC of the soil was increased with green manuring, but the effect of farmyard manure and fertilizers were rather small (Maurya and Ghosh, 1972) Organic matter application had raised the CEC of paddy soils in the permanent manurial experiments conducted at Pattambi (Kurumthottical, 1982)

Results of a long term field study with farmyard manure and pig slurry showed that CEC of soil was significantly higher with farmyard manure than with pig slurry (N'dayegamiye and Cote 1989) Thompson *et al* (1989) reported that on an average, organic matter contributed 49 per cent of the CEC of the fractionated materials in four soils (two Hapludalfs and two Argiudolls)

An investigation was carried out by Leboudi *et al* (1988) to study the effect of adding different industrial organic wastes produced from either orange or guava to both calcarious and silty clay loam soils They observed that CEC was not greatly affected in the calcarious sandy soil although being slightly responded in the silty clay loam soil Increase in CEC by the application of farmyard manure alone or in combination with fertilizers was noticed in the permanent manurial experiment conducted at Chotanagpur (Sharma *et al* , 1988)

7. Coir pith as a soil moisture conservant

Loganathan and Lakshminarasimhan (1979) observed that application of coir dust at the rate of 56 t ha^{1} improved the water retentivity of the porous and open textured red sandy soil In a field experiment conducted in a heavy black soil of Periyar-Vaigai command area at Madurai district with different soil amendments Mayalagu (1983) observed that the plots treated with 20 tonnes of coir waste per hectare recorded the highest moisture content at any time after irrigation maximum waterholding capacity, infiltration rate and hydraulic conductivity of soil and the lowest *in situ* bulk density compared to other treatments

Loganathan (1990) **reported that physical characters like** infiltration rate, total porosity and hydraulic conductivity of red soil with distinct hard pan, were improved by the application of coir dust at the rate of 2 5 t ha^{-1} and 5 t ha^{-1} Ramaswamy and Kothandaraman (1991) conducted experiments using coir pith and pressmud for moisture conservation in the soil and they observed that soil moisture conservation was the highest at 20 t ha^{-1} level in addition to enhancing the hydraulic conductivity of the soil Veerabadran (1991) reported that application of uncomposted coir pith at the rate of 12 5 t ha^{-1} increased soil moisture content by 0 58 to 1 22 per cent and by 0 45 to 1 27 per cent with the application of raw coir pith over no manure application Singaram and Pothiraj (1991) suggested that application of 10 t ha^{-1} of either raw or composted coir pith gave significant increase in yield of maize and finger millet in polluted soils The increased yield was due to improvement in physical condition and keeping the soil moist preventing capillary rise of salts to the surface Gopalaswamy *et al* (1991) reported that coir pith can be used as an alternative to pressmud for improving the physical condition of the soil

8. Effect of organic materials on the changes in nutrient availability

8 1 Available nitrogen

Muthuvel *et al* (1977) reported that continuous application of organic matter had no effect on available nitrogen content of soil under irrigated condition In the permanent manurial experiment on dwarf indica variety of rice at Pattambi, significant variation was noticed in available N content of soil The highest value of 100 kg ha^{-1} was observed in treatment where 90 kg N ha^{-1} was supplemented through organic and inorganic sources together with P_2O_5 and K_2O The lowest amount of available N was noticed in treatment which received only NPK fertilizers (Kurumthottical, 1982) Results of ^{15}N studies showed that availability of N freshly incorporated into the organic fraction decreased progressively over a long period (Stevenson, 1982) Ravikumar and Krishnamoorthy (1986) reported that available N content of vertisol was improved by the application of organic amendments like farmyard manure and poultry manure Nambiar *et al* (1988) studied the effect of blending coconut coir dust with fertilizers on the changes in carbon and nitrogen fractions in a coastal sandy soil of Kerala Results indicated that available nitrogen decreased progressively with time of incubation in all the treatments

Increase in available nitrogen content of soil upto 20 days after farmyard manure application and a decrease thereafter was noticed in a long term field experiment with wheat (Gupta *et al* 1988) Loganathan (1990) reported an increase in available N status of soil due to application of amendments like coir dust, farmyard manure and groundnut shell powder

8 2 Available P

Long term effects of four rotations and application of farmyard manure and fertilizers indicated that farmyard manure increased the available P_2O_5 content of soil (Havanangi and Mann, 1970) Ramaswami (1979) conducted an experiment in rice to study the influence of graded doses of rice straw application with and without different sources of phosphorus for photochemical nitrogen fixation for better yield As the dose of straw increased, available phosphorus also increased Gupta *et al* (1988) reported that available phosphorus increased upto 52 days after application of farmyard manure irrespective of the levels in a long term field experiment conducted with wheat They noticed a decrease in available phosphorus after 52 days In a trial to find out the response of wetland rice to nitrogenous fertilizers in soils amended with organic manures, it was found that organic manures exhibited residual effect in terms of available phosphorus (Maskina *et al* , 1988) Loganathan (1990) observed an increase in available phosphorus of soil due to application of amendments like coir dust, farmyard manure and groundnut shell powder Santhi *et al* (1991) reported that available phosphorus was increased upto 30 per cent with the application of composted coir pith at the rate of 10 t ha^{-1} with inorganic nitrogen in an experiment conducted in rice crop

8 3 Available K

Increase in the available K status of soil by the application of farmyard manure was reported by several workers (Kanwar and Prihar, 1962, Singh *et al* , 1983, Kaushik *et al* , 1984)

Leboudi *et al* (1988) observed that adding organic residues into soil lead to general significant positive increase in the content of available K Santhi *et al* (1991) reported that available K increased by 44 per cent with the addition of composted coir pith at the rate of 10 t ha^{-1} along with inorganic nitrogen in rice crop

Materials and Methods

MATERIALS AND METHODS

The present investigation was undertaken at the College of Horticulture, Vellanikkara during 1991-93 In order to meet the specific objectives set out, two separate experiments were conducted as outlined below

1. Experiment No.1

Monitoring the physico-chemical changes in soil due to the addition of organic amendments

2. Experiment No.2

Evaluation of the water retention property of coir pith using *in vitro* study

1.1 Materials

The following materials were used for this study

1 Soil

Three major soil groups of Kerala were made use of Coastal sandy soil was collected from Vadanappilly of Thrissur district which belonged to Manathala Series Laterite soil was collected from Vellanikkara of Thrissur district belonging to Vellanikkara series Red soil was composited from Thiruvallam of Trivandrum district which belonged to Vellayani series The profile description of each soil type is given in appendix I, II and III

All the samples were collected from a depth of 50 cm The samples were composited after the removal of stones and pebbles Preliminary analysis of the physico-chemical properties of the soil samples were done as per the standard methods

2. Coir pith

Raw coir pith was collected from St Joseph Fibre Works Kandassankadavu where coir fibre being extracted mechanically Chemical composition of the coir pith was determined as per the standard methods (Jackson, 1958) The data are presented in appendix IV

3 Farmyard manure (FYM)

The chemical composition of FYM is given in Appendix-IV

1.2 Methodology

1 2 1 **Design** Factorial experiment in completely randomised design

1 2 2 Replication 3

1 2 3 Factors and levels

<u>Soil</u>

Coastal sandy	-	S
Laterite	-	L
Red	-	R

<u>Levels of coir pith</u>

Absolute control	-	Co
Coir pith @ 5 t ha^{1}	-	C_1
Coir pith @ 10 t ha^{1}	-	C_2
Coir pith @ 20 t ha^{1}	-	C_3

<u>Control</u>

Coastal sandy soil + FYM @ 5 t ha^{1}	-	SF
Laterite soil + FYM @ 5 t ha^{1}		LF
Red soil + FYM @ 5 t ha^{1}	-	RF

1 2 4 Treatments

The treatment combinations are as follows

Treatment combinations	Notation
Coastal sandy soil alone (Absolute control)	SC_0
Coastal sandy + Coir pith @ 5 t ha^{1}	SC_1

Coastal sandy + Coir pith @ 10 t ha ^{1}	SC_2
Coastal sandy + Coir pith @ 20 t ha ^{1}	SC_3
Coastal sandy + FYM @ 5 t ha ^{1}	SF
Laterite soil alone (Absolute control)	LC_0
Laterite + Coir pith @ 5 t ha ^{1}	LC_1
Laterite + Coir pith @ 10 t ha ^{1}	LC_2
Laterite + Coir pith @ 20 t ha ^{1}	LC_3
Laterite + FYM @ 5 t ha ^{1}	LF
Red soil alone (Absolute control	RC_0
Red soil + Coir pith @ 5 t ha ^{1}	RC_1
Red soil + Coir pith @ 10 t ha ^{1}	RC_2
Red soil + Coir pith @ 20 t ha ^{1}	RC_3
Red soil + FYM @ 5 t ha ^{1}	RF

Pots of convenient size were filled with 10 kg each of soil (soil + coir pith or FYM) as detailed above

1.3 Analytical procedures

Incubation study was carried out for a period of one year and the samples were collected at quarterly intervals for the determination of volume-mass relationships water stable aggregates, organic carbon, CEC and moisture retention

1 3 1 Volume-mass relationships

Volume-mass relationships were determined by using Keen Raczkowski (1921) method and the computations were done using the formulae given below

$$\text{Bulk Density (B D)} = \frac{\text{Weight of air dried soil}}{\text{Total volume of soil}}$$

$$\text{Maximum water holding capacity (MWHC)} = \frac{\text{Weight of maximum water retained}}{\text{Weight of air dried soil}} \times 100$$

$$\text{Percent pore space (\% pore space)} = 1 - \frac{\text{B D}}{\text{Particle Density}} \times 100$$

1 3 2 Water stable aggregates

The analysis was based on the technique developed by Yoder (1936) Four parameters were worked out namely per cent aggregate stability, mean weight diameter (MWD), stability index and structural coefficient

1 3 3 Organic carbon

The organic carbon content of the soil was determined by Walkley and Black method as described by Piper (1942)

1 3 4 Cation exchange capacity (CEC)

The CEC was determined flame photometrically after saturating the exchange sites with K Five grams of soil was weighed out into a 15 ml centrifuge tube Potassium saturation was obtained by five washings with 1N KCl solution using 10 ml at a time Removal of excess of salt was done by washing once with distilled water and twice with 95 per cent ethanol 10 ml each and once with 10 ml acetone To the sample 10 ml of one normal NH_4Cl solution was added and the suspension was centrifuged This was done five times and each time the supernatent liquid was quantitatively transferred to 100 ml volumetric flask The volume was diluted to the mark with 0 5 N NH_4Cl and K was estimated in the solution using a flame photometer (Jackson, 1969)

1 3 5 Soil moisture retention

Soil moisture retentions were measured by using pressure plate apparatus (Richards, 1947) at applied pressures of 30 kPa, 500 kPa, 1000 kPa and 1500 kPa

2. Experiment No.2

2.1 Materials

Materials were same as outlined in section 1 1 As per the treatment combinations, 45 pots were taken where the cocoa seedlings were planted Cocoa, *Theobroma cacao* L is a shade loving plant belonging to the family Sterculiaceae

2.2 Methodology

After planting the cocoa seedlings in the respective pots, irrigation was given with measured quantity of water till each treatment attained field capacity The whole irrigation was scheduled in a manner as and when the plant showed temporary wilting symptoms

2.3 Observations

2 3 1 Water consumption

The total amount of water applied in each pot was calculated for a period of six months Frequency of irrigation was also noted

2 3 2 Available N, P & K of the soil

Available N in the soil was determined by alkaline permanganate method (Subbiah and Asija, 1956) Available P was extracted by Bray and Kurtz No 1 extract and determined by chlorostannous reduced molybdophosphoric blue colour method in HCl system (Jackson, 1958) Available K was determined flame photometrically in neutral normal ammonium acetate extract of the soil (Jackson 1958)

2 3 3 Uptake of N, P & K by the plants

Plant samples were dried in a hot air oven at 70°C and the dry weights were recorded The samples were powdered and stored for further analysis The total nitrogen content of the samples was determined by micro kjeldahl digestion and distillation method (Jackson 1958) For the determination of P & K tri acid extract (HNO_3 H_2SO_4 $HClO_4$ in the ratio of 10 1 4) of the plant material was made use of Phosphorous was determined by Vanado molybdo phosphoric yellow colour method (Jackson 1958) Potassium was determined by using EEL flame photometer

2 3 4 Statistical analysis

Data generated on the various parameters of experiment were analysed statistically by using the analysis of variance In case the effects were found to be significant critical difference was calculated for making logical comparisons between treatment means (Panse and Sukhatme 1985) Correlation and regression between various factors were worked out as described by Snecdor and Cochran (1967)

Results and Discussion

RESULTS AND DISCUSSION

The results obtained are presented and discussed below

1. Basic physico-chemical properties of soils under study

Three different soil groups namely coastal sandy (S), laterite (L) and red soil (R) were made use of and the physico-chemical properties of the soils are detailed in Table 1

1.1 Particle size analysis

Appreciable variation in soil texture was observed in relation to soil groups Data revealed that the coastal sandy soils contained 75 8 per cent of coarse sand, 11 5 per cent fine sand, 4 9 per cent of silt and 7 8 per cent clay, making the texture loamy sand The laterite soil belonged to the textural group clay loam as there was variation in the contents of coarse sand (27 3%), fine sand (19 2%), silt (12 1%) and clay (41 4%) The red soil possessed sandy loam texture The content of coarse sand (19 4%) was found to be less and that of fine sand (60 9%) was exceptionally higher as compared to coastal sandy and laterite soils The silt content (3 1%) was lower than the other two soils The clay content (16 6%) was higher than that of coastal sandy soil but lower than that of laterite

Table 1 Basic physico chemical properties of original soil samples used for the study

			Coastal sandy	Laterite	Red
I	Physical properties				
1	Mechanical composition %				
	a	Clay	7 8	41 4	16 6
	b	Silt	4 9	12 1	3 1
	c	Fine sand	11 5	19 2	60 9
	d	Coarse sand	75 8	27 3	19 4
2	Volume mass relationships				
	a	Bulk density g cm ^{3}	1 64	1 29	1 30
	b	Maximum water holding capacity %	22 42	40 56	31 56
	c	Pore space %	30 36	45 05	40 17
3	Aggregate analysis				
	a	Structural coefficient	0 36	0 42	0 31
	b	Stability index	30 40	40 70	34 10
	c	Per cent aggregate stability	31 00	42 00	37 00
	d	Mean weight diameter mm	0 52	1 13	1 01

Contd

Table 1 (Contd)

4	Soil moisture retention %			
	a 30 kPa	12 45	20 80	15 10
	b 100 kPa	12 13	19 90	14 02
	c 1000 kPa	10 40	17 50	12 02
	d 1500 kPa	9 83	17 10	12 73
II	Chemical properties			
1	Organic carbon %	0 26	1 36	0 51
2	Available N kg ha^{1}	94 08	221 00	208 00
3	Available P kg ha^{1}	20 30	28 12	10 80
4	Available, K kg ha^{1}	98 60	20 90	93 70

1 2 Volume-mass relationship

Coastal sandy soil possessed a bulk density of 1 64 g cm^{3} whereas it was 1 29 and 1 30 g cm^{3} respectively for laterite and red soil Maximum water holding capacity of coastal sandy soil was 22 42 per cent Laterite had a higher value (40 56%) and red soil came in between with a value of 31 56 per cent Coastal sandy soil, possessed a low per cent pore space (30 36%) compared to laterite (45 05%) and red soil (40 17%)

1 3 Aggregate analysis

Structural coefficient of coastal sandy soil was found to be 0 36 and for laterite soil it was 0 42 Red soil recorded a value of 0 31 Stability index of coastal sandy soil was 30 4 and that of laterite soil 40 7 Red soil registered an intermediary value of 34 1 Aggregate stability also recorded a same trend with values of 31, 42 and 37 per cent, respectively Mean weight diameter of coastal sandy soil was 0 52, for laterite soil 1 13 and for red soil 1 01

1 4 Soil moisture retention

Coastal sandy soil recorded the lowest moisture retention at 30 kPa and 1500 kPa with values of 12 45 per cent and 9 83 per cent respectively These values were 20 80 per cent and 17 10 per cent for laterite and 15 10 per cent and 12 73 per cent for red soil

1 5 Chemical properties

Organic carbon content of coastal sandy soil was 0 26 per cent 1 36 per cent for laterite and 0 51 per cent for red soil Available nitrogen contents were 94 08 221 and 208 kg ha $^{-1}$ respectively for coastal sandy, laterite and red soils Content of available phosphorus varied between 10 80 to 28 12 kg ha $^{-1}$ and that of potassium 98 60 and 209 kg ha $^{-1}$ with red soil registering the middle value in both cases

2 Experiment No I

Results obtained from the incubation experiment are described and discussed below

2 1 Changes in volume mass relationships

2 1 1 Bulk density

The bulk density of different soils as influenced by coir pith at different levels and farmyard manure are given in Table 2

Table 2 Effect of soil types, coir pith at different levels and FYM on bulk density, g cm^{3}

Treatments	Sampling interval months			
	3	6	9	12
Soil types (T)				
S	1 62	1 58	1 60	1 62
L	1 27	1 25	1 26	1 29
R	1 33	1 32	1 33	1 34
SEM±	0 006	0 004	0 005	0 005
CD (0 05)	0 019*	0 013*	0 013*	0 013*
Levels of coir pith (C)				
C_0	1 42	1 43	1 44	1 45
C_1	1 41	1 38	1 39	1 41
C_2	1 40	1 37	1 39	1 41
C_3	1 38	1 35	1 37	1 39
SEM±	0 007	0 005	0 005	0 005
CD (0 05)	NS	0 014*	0 015*	0 015*
Interaction (TxC)				
SC_0	1 64	1 64	1 65	1 65
SC	1 63	1 60	1 61	1 62
SC_2	1 62	1 57	1 58	1 62
SC_3	1 58	1 51	1 56	1 59
LC_0	1 29	1 30	1 31	1 31
LC	1 26	1 22	1 24	1 27
LC_2	1 25	1 24	1 24	1 28
LC_3	1 27	1 26	1 27	1 28
RC_0	1 34	1 35	1 37	1 39
RC	1 34	1 32	1 32	1 33
RC_2	1 33	1 31	1 34	1 35
RC_3	1 29	1 28	1 28	1 30
SEM±	0 013	0 009	0 009	0 009
CD (0 05)	NS	NS	NS	NS
Control				
SF	1 63	1 58	1 63	1 63
LF	1 26	1 25	1 26	1 29
RF	1 32	1 31	1 33	1 33
SEM±	0 02	0 02	0 02	0 02
CD*(0 05)	0 058*	0 058*	0 058*	0 058*

CD* - CD for comparing control with all other treatment combinations

The bulk density differed significantly with different types of soil at all the sampling intervals The maximum bulk density was recorded by coastal sandy soil (1 62 g cm^{3}) and the minimum by laterite soil (1 27 g cm^{3}) at the third month of incubation The red soil occupied an intermediary position by registering a value of 1 33 g cm^{3} Almost the same trend was followed at all the other stages of incubation

The data also reveals the effect of coir pith on the BD of soil The levels of coir pith influenced BD significantly from sixth month onwards Even at the initial stage of incubation the effect was noticeable with a progressive reduction of BD with increase in levels of application This was getting more and more pronounced over the period and it registered the lowest value of 1 35 g cm^{3} with C_3 (20 t ha^{1}) at the sixth month of incubation However towards the end of the incubation the BD was increasing and it resumed almost the initial position with all the levels of coir pith application With FYM also the BD at different sampling intervals recorded a similar trend

The interactions between soils and different levels of coir pith were not significant at any stage of incubation But comparatively lower values were always registered by all soil types with higher levels of coir pith For example it lowered from 1 64 to 1 58, 1 29 to 1 27 and 1 34 to 1 29 g cm^{3} respectively for coastal sandy, laterite and red soil at the initial stage of incubation with C_3 level (20 t ha^{-1}) This trend also remained almost static over the stages with all soil types

Bulk density was found to be influenced by both the levels of coir pith and stages of sampling as the bulk application of organic matter tends to lower the weight per unit volume of soils This encourages granulation properties like porosity, friability and aggregation of soil and that the influence is also temporarily bound With progressive addition of coir pith the soil becomes more and more fluffy and porous which in turn result in respective reduction in BD Similar results are also reported by Mayalagu (1993)

The influence of time is also important in encouraging the granulation characteristics of the soil as evident from the insignificant initial values From the values it is indicated that a minimum period of three months are required to get the coir pith properly decomposed and added to the desirable physical properties of the soil The granulation effects may continue upto one year The increase in BD towards the 12th month of incubation is the indication of the decline in desirable effects which may be attributed to the depletion of organic carbon as evident and explained in section 2 4

The insignificant interaction effect further tells that the desirable physical property build up is solely influenced by the coir pith application and is regardless of the textural properties of soil This is suggestive of the fact that coir pith is as good a soil conditioner as that of FYM in all the three soil types under study

2 1 2 Maximum water holding capacity (MWHC)

Changes in MWHC due to different treatments are given in Table 3 It was evident from the data that water holding capacity was significantly influenced by different soil types throughout the period of incubation Laterite soil showed the highest value (44 58%) followed by red soil (35 44%) and the lowest value by coastal sandy soil (26 05%) at the third month of incubation The same trend was followed for other stages also As compared to red and coastal sandy soils the laterite soil might be rich in clay and organic matter content and so the water holding capacity would be more

Application of different levels of coir pith also showed significant effect in MWHC As the level of coir pith increased the water holding capacity of the soil also increased The highest value was recorded by the highest level (20 t ha^{-1}) of coir pith application at all stages of incubation This might be due to the decrease in B D of the respective soil types with the addition of coir pith as described in section 2 1 1 This finding is in agreement with Malayagu (1983)

Table 3 Effect of soil type, coir pith at different levels and FYM on maximum water holding capacity, per cent

Treatments	Sampling interval, months			
	3	6	9	12
Soil types (T)				
S	26 05	28 34	25 36	23 18
L	44 58	46 38	43 62	40 92
R	35 44	37 50	34 02	31 86
SEM±	0 197	0 222	0 159	0 138
CD (0 05)	0 568*	0 641*	0 459*	0 399*
Levels of Coir pith (C)				
C_0	33 73	35 60	33 13	31 16
C	34 63	36 72	33 61	31 60
C_2	35 19	36 95	34 09	31 87
C_3	37 87	40 35	36 51	33 32
SEM±	0 227	0 256	0 183	0 159
CD (0 05)	0 656*	0 739*	0 529*	0 462*
Interaction (TxC)				
SC	24 70	26 63	23 99	22 00
SC	24 77	26 79	24 19	22 43
SC	25 61	27 81	24 58	22 69
SC	29 12	32 12	28 67	25 60
LC	42 60	44 44	42 16	40 30
LC	44 27	46 47	43 11	41 14
LC	44 23	44 74	43 31	41 23
LC_3	47 21	49 88	45 90	40 99
RC	33 90	35 73	33 22	31 16
RC	34 86	36 91	33 52	31 23
RC	35 73	38 31	34 39	31 69
RC	37 26	39 05	34 94	33 38
SEM±	0 394	0 444	0 318	0 277
CD (0 05)	NS	1 28*	0 917*	0 799*
Control				
SF	25 62	27 74	24 53	22 42
LF	43 74	45 76	42 83	41 06
RF	36 13	38 63	34 24	32 13
SEM±	1 16	1 15	1 14	1 11
CD* (0 05)	3 35*	3 32*	3 29*	3 204*

CD* - CD for comparing control with all other treatment combinations

Except at the third month of incubation there was significant difference in MWHC for the interactions between soil and coir pith at all the stages of incubation At the sixth month of incubation the highest value of MWHC (49 88%) was recorded by LC_3 and the lowest value (26 63%) by SC_0 Almost the same trend was followed for the subsequent stages

There was significant difference between the three soil types with regard to the effect of FYM on MWHC. However the variations in MWHC mainly reflected the textural variations of different soil types The treatment SF (25 62%) was found to be on par with SC_0, SC_1 and SC_2 However SC_3 (29 12%) was found to be significantly superior to SF Likewise LC_0, LC_1 and LC_2 were on par with LF (43 74%) but LC_3 (47 21%) was found to be superior to LF The treatments RC_0, RC_1 and RC_2 were on par with RF (36 13%) But RC_3 (37 26%) was superior to RF

From these observations it was clear that addition of 20 t ha^{-1} of coir pith is a better treatment compared to the application of FYM at the rate of 5 t ha^{-1} But the lower levels of coir pith application are found to be on par with FYM at the same rate of application

2.1.3 Per cent pore space

The changes in per cent pore space of the soil brought about by different treatments are shown in Table 4 Different

Table 4 Effect of soil types, coir pith at different levels and FYM on pore space, per cent

Treatments	Sampling interval			
	3	6	9	12
Soil types (T)				
S	34 89	36 13	34 67	33 34
L	46 76	48 40	47 35	45 55
R	42 34	43 59	43 16	41 91
SEM±	0 528	0 358	0 483	0 399
CD (0 05)	1 52*	1 034*	1 395*	1 152*
Levels of Coir pith (C)				
C_0	40 16	41 39	40 112	38 35
C_1	40 71	42 94	41 87	40 53
C_2	42 51	45 44	43 84	39 94
C_3	41 95	41 06	41 09	42 24
SEM±	0 609	0 414	0 558	0 461
CD (0 05)	NS	1 194*	NS	1 33*
Interaction (TxC)				
SC	33 99	33 62	34 67	34 05
SC	33 16	34 97	32 81	31 73
SC_2	35 71	36 80	34 55	32 84
SC_3	36 69	39 14	36 55	34 72
LC_0	47 47	47 98	47 04	45 88
LC	45 80	46 49	45 40	42 79
LC_2	45 25	47 33	46 94	45 87
LC_3	48 54	51 79	50 01	47 68
RC_0	41 68	41 57	41 56	39 89
RC	41 52	42 72	42 12	40 53
RC_2	42 90	44 70	44 11	42 90
RC_3	43 27	45 37	44 85	44 31
SEM±	1 055	0 716	0 966	0 798
CD (0 05)	NS	NS	NS	NS
Control				
SF	34 03	36 54	35 46	32 60
LF	49 37	53 11	50 79	50 01
RF	42 83	44 61	43 48	42 44
SEM±	0 83	0 88	0 88	0 89
CD* (0 05)	2 394*	2 54*	2 54*	2 569*

CD* - CD for comparing control with all other treatment combinations

types of soil showed significant influence on per cent pore space, at all the stages of incubation At the third month of incubation laterite soil showed the highest value (46 76%) and coastal sandy soil, the lowest value (34 89%) The same trend was followed in other stages also

Coir pith application showed no significant effect on per cent pore space in the third and ninth month of incubation Significant difference in values of per cent pore space was noticed for 6th and 12th months of incubation As the level of coir pith increased, the per cent pore space also increased significantly at all the stages of incubation The highest value was recorded by coir pith application @ 20 t ha^{-1} at all the stages and at the 12th month, C_3 recorded a value of 42 24 per cent

There was no significant difference in soil coir pith interactions at any stages of sampling However the effect of soil-FYM combinations was found to be significant at all stages of sampling This is due to the variations in the clay content and BD of different soil types When the FYM-soil combinations was compared with soil-coir pith interaction it was observed that the treatment SC_3 was significantly different from SF on 3rd and 6th month of incubation and not significantly different at the 9th and 12th month of incubation Besides the treatment combinations SC_0, SC_1 and SC_2 were found to be on par with SF The treatment LF was found to be on par with LC_3 at all stages of sampling and found to be superior to the treatment combinations, LC_0, LC_1 and LC_2 For red soil the treatment combination RF was on par with RC_0, RC_1, RC_2 and RC_3

2 2 Water stable aggregates

Four different parameters namely per cent aggregate stability, mean weight diameter (MWD), stability index and structural coefficient were found out and the data are given in Table 5

2.2.1 Per cent aggregate stability

From the data, it was observed that different soil types had significant influence on per cent aggregate stability Laterite soil recorded the highest value (45 50) and the coastal sandy soil the lowest (36 75) The red soil recorded a value (39 75) This might be due to the textural difference of the soil types which greatly influences aggregate stability The clay and silt content had a positive effect on aggregation of the soil particles unlike the sand particles of the soil High content of clay and silt in laterite might have contributed to high aggregate stability compared to coastal sandy and red soil Low content of clay and high percentage of coarse sand might have resulted in less aggregate stability of the coastal sandy soil

Different levels of coir pith had significant influence on per cent aggregate stability As the level of coir pith

Table 5 Effect of soil types, coir pith at different levels and FYM on different attributes of water stable aggregates

Treatments	Per cent aggregate stability	Mean weight diameter, mm	Stability index	Structural coefficient
Soil types (T)				
S	36 75	0 581	33 92	0 367
L	45 50	1 194	44 98	0 496
R	39 75	1 036	35 77	0 407
SEM±	0 738	0 011	0 292	0 007
CD (0 05)	2 129*	0 031*	0 844*	0 019*
Levels of Coir pith (C)				
C_0	37 11	0 889	36 41	0 373
C_1	39 44	0 901	37 03	0 373
C_2	40 44	0 922	37 86	0 432
C_3	45 67	1 036	41 61	0 513
SEM±	0 852	0 012	0 338	0 008
CD (0 05)	2 459*	0 035*	0 975*	0 023*
Interaction (TxC)				
SC_0	31 67	0 550	32 57	0 313
SC	37 00	0 570	33 07	0 313
SC_2	36 33	0 573	33 30	0 363
SC_3	42 00	0 630	36 77	0 477
LC_0	42 33	1 127	42 57	0 437
LC_1	43 00	1 130	42 93	0 423
LC_2	45 00	1 177	44 70	0 547
LC_3	51 67	1 343	50 23	0 577
RC_0	37 33	1 133	34 60	0 373
RC	38 33	1 127	35 10	0 383
RC_2	40 00	1 003	35 57	0 387
RC_3	43 33	1 017	37 83	0 487
SEM±	1 475	0 990	0 585	0 014
CD (0 05)	NS	NS	1 689*	0 040*
Control				
SF	32 33	0 567	33 87	0 323
LF	43 33	1 153	43 83	0 463
RF	38 00	1 013	35 43	0 367
SEM±	0 80	0 04	0 78	0 01
CD* (0 05)	NS	0 115**	2 252*	0 029

CD* - CD for comparing control with all other treatment combinations

increased the value of per cent aggregate stability also increased The highest value was given by C_3 (45 67) and the lowest by C_0 (37 11) The reason for this variation is that the carbon derived from lignin rich material accumulates mostly in the stable humin and other humic fractions Humic substances are permanent aggregate binding agents involved in the stabilization of soil micro aggregates

Soil-coir pith interactions and soil-FYM combinations had no significant influence on per cent aggregate stability

2 2.2 **Mean weight diameter (MWD)**

Different soil types had significant influence on MWD The highest value of MWD was recorded by laterite soil (1 194) and the lowest by coastal sandy soil (0 581) The red soil occupied a position in between these two (1 036) These differences are due to the textural differences of different soil types

Different levels of coir pith influenced MWD significantly As the level of coir pith increased MWD also increased The highest value was given by C_3 (1 036), and the lowest value by C_0 (0 889)

The interaction between soil and coir pith had got no significant influence on MWD But soil-FYM combinations were found to be significantly influencing the MWD The highest value was given by LF (1 153) and the lowest by SF (0 567) The treatment RF gave an intermediary value (1 013) This may be due to the formation of water stable macro aggregates that form quickly when easily decomposable FYM was added to the soil These rapid (transient and temporary) changes in aggregate stability can be related to soil microflora and more specifically to filamentous microorganisms Wider C/N ratio and high lignin content of coir pith cause low decomposition rates in soil and there was no effect on MWD of different soil types

2 2.3 Stability index

There was significant influence on stability index as influenced by different types of soil The highest value of stability index was shown by laterite soil (44 98) and the lowest by coastal sandy soil (33 92) Red soil recorded a value which came in between these two (35 77) These changes were due to the difference in textural composition and inherent organic matter content of the soil

Different levels of coir pith were found to be influencing the stability index significantly The highest value was given by C_3 (41 61) and the lowest by C_0 (36 41) Interactions between soil and coir pith and soil-FYM combinations were found to be influencing stability index significantly When soil-coir pith interactions and soil-FYM combinationswere compared it was observed that the treatment SC_3

SC_3 was found to be superior to SF and SC_0, SC_1 and SC_2 were on par with SF Likewise LC_3 was superior to LF and LC_0, LC_1 and LC_2 were on par with LF Similarly the treatment combination RC_3 was found to be superior to RF and RC_0, RC_1 and RC_2 were on par with RF From this, it is evident that lignin rich coir pith materials can influence the stability index of various soil types

Lignin, a phenolic polymer is relatively resistant to biological decay However it is considered as a source of substrate for humus formation Carbon derived from ligneous material accumulated mostly in the stable humus fractions Humic substances are permanent aggregate binding agents involved in the stabilization of soil micro aggregates

2 2 4 Structural coefficient

There was significant influence in structural coefficient as influenced by different soil types Laterite soil showed the highest value (0 496) and the coastal sandy soil recorded the lowest value (0 367) The red soil recorded a value (0 407) The difference in the values of structural coefficient may be due to the difference in the textural composition of these soil types The clay and silt content had a positive influence on soil aggregation and sand content had a negative effect High content of clay and silt in laterite might have contributed to high structural coefficient in laterite soil whereas the low contents of clay and silt and high content of sand might have contributed to low structural coefficient in coastal sandy soil

Different levels of coir pith also had a significant influence on structural coefficient As the level of coir pith increased the value of structural coefficient also increased The highest value was given by C_3 (0 513) and the lowest by both C and C_0 which gave a value of 0 373 Soil-coir pith interaction and soil-FYM combinations were found to be significantly influencing the structural coefficient On comparison of these two interactions it was observed that SC_2 (0 363) and SC_3 (0 477) were significantly superior to SF (0 323) and SC_0 and SC_1 (0 313) were on par with SF Like wise LC_2 (0 547) and LC_3 (0 577) were significantly superior to LF (0 463) The treatments LC_0 (0 437) and LC_2 (0 423) were on par with LF Similarly RC_3 (0 487) was found to be superior to RF (0 367) The treatments RC_0 (0 373), RC_1 (0 383) and RC_2 (0 387) were on par with RF The increase in structural coefficient is due to the lignin derived from the coir pith. Lignin is considered to be a substrate for humus formation The humic substances are responsible for the structural stability of soil aggregates

2 3 Changes in soil moisture retention

2 3 1 Soil moisture retention at 30 kPa

Changes in soil moisture retention at 30 kPa are given in Table 6 From the data it is evident that different soil types have significant influence on moisture retention at all stages of sampling At the third month of sampling laterite soil recorded the highest value (18 77%) and the coastal sandy soil recorded the lowest value (12 82%) of moisture retention Red soil recorded a value (15 21%) which came in between those of laterite and coastal sandy soils Same trend was followed in other stages also

Influence of different levels of coir pith on moisture retention was significant at 6th and 9th month of incubation At the 6th month of sampling coir pith applied @ 20 t ha^{1} (C recorded the highest value (17 02%) and the lowest by C (15 05%) From this it is clear that as the level of coir pith decreased the moisture retention also decreased At the 9th month of sampling also C_3 recorded the highest value (16 69% and the lowest by C_0 (15 03%)

Soil-coir pith interactions had no significant influence on moisture retention at any stages of incubation However the control treatments (soil and FYM) significantly influenced the moisture retention at 30 kPa When comparing control treatments

Table 6 Effect of soil types, coir pith at different levels and FYM on soil moisture retention at 30 kPa, per cent

Treatments	Sampling interval, month			
	3	6	9	12
Soil types (T)				
S	12 82	13 11	13 46	12 79
L	18 77	19 24	19 12	19 46
R	15 21	15 59	15 24	15 26
SEM±	0 208	0 183	0 239	0 23
CD (0 05)	0 600*	0 528*	0 689*	0 664*
Levels of Coir pith (C)				
C_0	14 86	15 05	15 03	14 93
C_1	15 67	15 97	16 05	15 94
C_2	15 52	15 89	16 01	15 89
C_3	16 33	17 02	16 69	16 58
SEM±	0 208	0 21	0 276	0 266
CD (0 05)	NS	0 606*	0 797*	NS
Interaction (TxC)				
SC_0	12 2	12 26	12 20	11 59
SC	12 79	13 63	13 85	13 16
SC_2	12 47	12 63	13 75	13 06
SC_3	13 75	13 13	14 05	13 34
LC_0	17 86	18 18	18 57	18 60
LC	18 94	19 02	18 93	19 34
LC	18 92	19 34	19 11	11 36
LC_3	19 34	20 43	19 88	20 48
RC	14 47	14 70	14 31	14 53
RC	15 21	15 26	15 36	15 32
RC_2	15 18	15 72	15 16	15 25
RC_3	15 89	16 69	16 13	15 94
SEM±	0 00	0 365	0 478	0 460
CD (0 05)	NS	NS	NS	NS
Control				
SF	12 39	12 59	12 79	12 18
LF	19 25	19 36	18 37	19 52
RF	16 29	16 37	16 35	16 39
SEM±	0 40	0 41	0 39	0 44
CD* (0 05)	1 15*	1 18*	1 13*	1 27*

CD* - CD for comparing control with all other treatment combinations

with soil coir pith interaction it was observed that SC_3 was superior to SF (12 39%) and SC_0, SC_1 and SC_2 were on par with SF The treatment LF (19 25%) was on par with LC , LC_2 and LC_3 and significantly superior to LC_0 The treatment RF (16 29%) was found to be superior to RC_0 (14 47%) and on par with RC_1, RC_2 and RC_3 The same trend was noticed at other stages of incubation

Here it is observed that only in the case of coastal sandy soil the coir pith application @ 20 t ha was found to be superior to other treatments and in the case of laterite and red soils coir pith application @ 20 t ha^{1} was found to be on par with other treatments except C_0 From this observation it may be concluded that the effect of coir pith application @ 20 t ha^{1} was more prominent in the case of coastal sandy soil as far as moisture retention at field capacity was concerned

2 3.2 Moisture retention at 500 kPa

Changes in soil moisture retention at 500 kPa are given in Table 7 It was observed that different types of soil influenced moisture retention significantly throughout the period of incubation At the third month of sampling laterite soil recorded maximum water retention (15 62%) followed by red soil (12 34%) and coastal sandy soil (10 88%)

Coir pith application also influenced moisture retention significantly at all stages of incubation As the level of coir

Table 7 Effect of soil types, coir pith at different levels and FYM on soil moisture retention at 500 kPa, per cent

Treatments	Sampling interval, months			
	3	6	9	12
Soil types (T)				
S	10 88	11 12	11 15	11 08
L	15 62	15 88	16 14	15 95
R	12 34	12 26	12 58	12 29
SEM±	0 082	0 046	0 33	0 078
CD (0 05)	0 236*	0 133*	0 095*	0 224*
Levels of Coir pith (C)				
C_0	12 59	12 31	12 33	12 06
C_1	12 70	12 84	12 95	12 81
C_2	13 00	13 26	13 42	13 32
C_3	13 48	13 94	14 47	14 23
SEM±	0 094	0 053	0 038	0 089
CD (0 05)	0 272*	0 154*	0 109*	0 259*
Interaction (TxC)				
SC_0	10 72	10 73	10 70	10 68
SC_1	10 81	10 88	10 92	10 83
SC_2	10 82	10 99	11 02	10 92
SC_3	11 15	11 89	11 97	11 87
LC_0	14 98	15 04	15 18	15 06
LC	15 13	15 25	15 45	15 22
LC_2	15 63	16 17	16 42	16 18
LC_3	16 74	1 04	17 51	17 34
RC_0	12 06	11 18	11 10	10 44
RC_1	12 17	12 38	12 49	12 39
RC_2	12 55	12 61	12 89	12 85
RC_3	12 55	12 88	13 92	13 47
SEM±	0 163	0 092	0 066	0 155
CD (0 05)	0 348*	0 216*	0 189*	0 448*
Control				
SF	10 80	10 90	10 99	10 85
LF	15 38	15 57	15 66	15 40
RF	12 53	12 92	12 88	12 76
SEM±	0 30	0 32	0 33	0 33
CD* (0 05)	0 87*	0 924*	0 953*	0 953*

CD* - CD for comparing control with all other treatment combinations

pith increased the moisture retention also increased At the 3rd month C_3 recorded the highest value (13 48%) and C_0 the lowest value (12 59%) The same trend was followed in other stages also

Interaction between soil and coir pith and soil-FYM combinations had significant influence on soil moisture retention at 500 kPa When these two interactions were compared it was observed that the treatment SF (10 80%) was on par with SC_0, SC_1, SC_2 and SC_3 However for laterite soil the treatment LC_3 (16 74%) was found to be superior to LF (15 38%) and LC_0, LC_1 and LC_2 were on par with LF In the case of red soil all the interactions with different levels of coir pith were found to be on par with RF The same trend was followed in other stages also

2 3 3 **Moisture retention at 1000 kPa**

Changes in moisture retention at 1000 kPa are given in Table 8 Soil types were found to be significantly influencing the moisture retention throughout the period of incubation Laterite occupied the top position by registering a value of 15 03 per cent followed by red soil (10 96%) and coastal sandy soil at the bottom position with a value of 10 44 per cent, at the 3rd month of incubation The same trend was followed in other stages of incubation

Table 8 Effect of soil types, coir pith at different levels and FYM on soil moisture retention at 1000 kPa, per cent

Treatments	Sampling interval, month			
	3	6	9	12
Soil types (T)				
S	10 44	10 59	10 67	10 64
L	15 03	15 02	15 17	15 11
R	10 96	11 02	11 08	11 12
SEM±	0 123	0 109	0 127	0 124
CD (0 05)	0 355*	0 314*	0 367*	0 358*
Levels of Coir pith (C)				
C_0	11 94	11 76	11 86	11 76
C_1	11 83	11 87	12 04	12 07
C_2	12 10	12 32	12 44	12 45
C_3	12 71	12 89	12 89	12 89
SEM±	0 143	0 125	0 147	0 143
CD (0 05)	NS	0 361*	0 424*	0 413*
Interaction (TxC)				
SC	10 42	10 40	10 43	10 40
SC	10 42	10 62	10 72	10 71
SC_2	10 45	10 65	10 75	10 71
SC	10 48	10 68	10 78	10 74
LC_0	14 72	14 45	14 67	14 52
LC	14 66	14 65	14 75	14 83
LC_2	14 79	14 90	15 25	15 13
LC_3	15 94	16 07	16 00	15 97
RC_0	10 68	10 44	10 48	10 35
RC	10 41	10 36	10 64	10 67
RC	10 06	11 41	11 61	11 52
RC_3	11 71	11 91	11 90	11 96
SEM±	0 247	0 217	0 254	0 248
CD (0 05)	NS	0 459*	NS	NS
Control				
SF	10 45	10 65	10 75	10 62
LF	14 94	15 14	15 18	15 07
RF	11 33	11 32	11 43	11 39
SEM±	0 32	0 31	0 31	0 31
CD*(0 05)	0 92*	0 895*	0 895*	0 895*

CD* - CD for comparing control with all other treatment combinations

Different levels of coir pith also influenced the moisture retention significantly at all the stages except in the 3rd month The highest value was recorded by C_3 and the lowest by C_0 at all the stages of the incubation From this it is clear that as the level of coir pith increased the moisture retention also increased

Soil-coir pith interactions did not influenced the moisture retention significantly at any stage except at the sixth month of incubation However soil-FYM combinations influenced the moisture retention significantly at all the stages of incubation When soil-coir pith interactions were compared with soil-FYM combinations, it was observed that SF (10 45%) was on par with SC_0, SC_1, SC_2 and SC_3, at the third month of sampling The treatment LF (14 94%), was found to be on par with LC_0, LC_1 and LC_2, but inferior to LC_3 (15 94%) The treatment RF (11 33%) was on par with RC_0, RC_1, RC_2 and RC_3 The same trend was followed in other stages also

2 3 4 Moisture retention at 1500 kPa

Data on the changes in moisture retention at 1500 kPa are given in Table 9 It was evident from the data that different soil types influenced soil moisture retention significantly at all the stages of incubation At the 3rdmonth laterite soil registered the highest value (13 16%) and the coastal sandy soil the lowest value (9 26%) Red soil came in

Table 9 Effect of soil types, coir pith at different levels and FYM on soil moisture retention at 1500 kPa, per cent

Treatments	Sampling interval, month			
	3	6	9	12
Soil types (T)				
S	9 26	9 4	9 47	9 31
L	13 16	13 22	13 24	13 31
R	9 99	10 09	10 13	10 21
SEM±	0 046	0 045	0 047	0 052
CD (0 05)	0 132*	0 129*	0 137*	0 151*
Levels of Coir pith (C)				
C_0	10 40	10 51	10 46	10 45
C_1	10 71	10 86	10 93	10 98
C_2	10 93	11 04	11 08	11 06
C_3	11 18	11 26	11 32	11 28
SEM±	0 053	0 052	0 055	0 061
CD (0 05)	0 153*	0 149*	0 158*	0 175*
Interaction (TxC)				
SC_0	9 04	9 21	9 08	8 99
SC	9 23	9 41	9 49	9 32
SC_2	9 34	9 52	9 61	9 42
SC	9 45	9 63	9 72	9 52
LC_0	12 44	12 54	12 55	12 58
LC	13 21	13 26	13 22	13 31
LC_2	13 24	13 33	13 34	13 43
LC_3	13 73	13 75	13 84	13 91
RC_0	9 73	9 76	9 75	9 78
RC	9 68	9 93	10 07	10 30
RC_2	10 22	13 33	10 30	10 32
RC_3	10 35	10 41	10 40	10 42
SEM±	0 092	0 089	0 095	0 105
CD (0 05)	0 362	NS	NS	NS
Control				
SF	9 31	9 49	9 58	9 38
LF	13 41	13 46	13 44	13 23
RF	10 23	10 23	10 22	10 19
SEM±	0 26	0 26	0 25	0 26
CD*(0 05)	0 751*	0 751*	0 722*	0 751*

CD* - CD for comparing control with all other treatment combinations

between these two (9 99%) The same trend was followed in other stages also

Different levels of coir pith also had significant influence on moisture retention at 1500 kPa At the first quarter C_3 recorded the highest value (11 18%) and the lowest by C_0 (10 40%) As the level of coir pith decreased the moisture content also decreased At other stages also the same trend was followed

Soil-coir pith interaction was found to be having no significant influence on moisture retention, except at the 3rd month of incubation However the soil-FYM combinations were found to be influencing the moisture retention significantly at all the stages of sampling On comparison of soil coir pith interactions with soil FYM combinations it was observed that all the interactions involving different levels of coir pith were found to be on par with the control treatment (soil + FYM) for each soil type

The effect of different treatments on the soil moisture retention at different tensions are well depicted in the soil moisture retention curves of the three soil types (Fig 1 Fig 2 and Fig 3) By examining the above observations in detail it may be concludedthat soil moisture retention has been enhanced indifferent soil types by coir pith at different levels and FYM

Fig. 1. Soil moisture retention curve of coastal sandy soil applied with different treatments

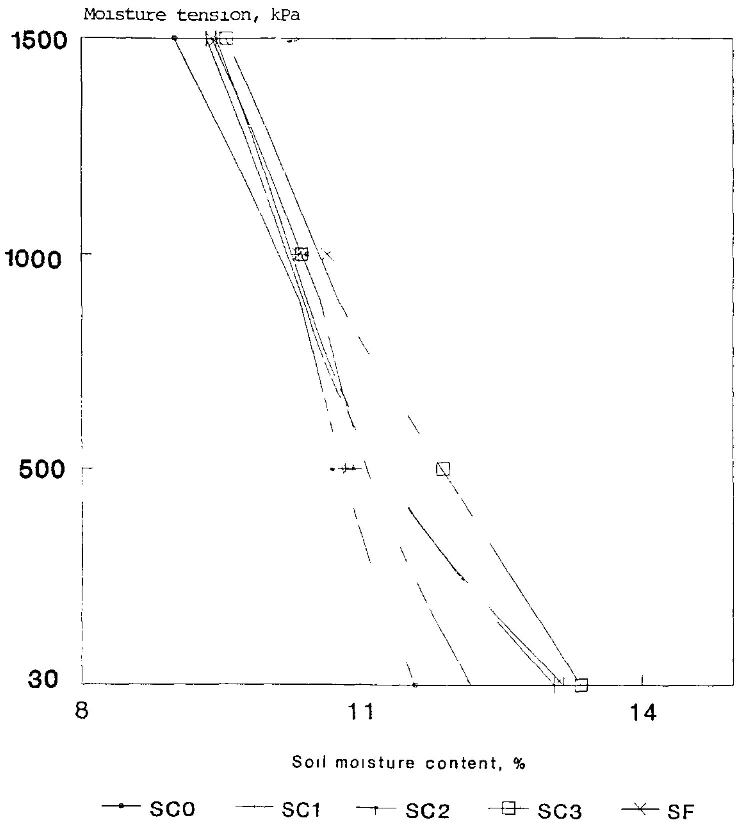


Fig 2. Soil moisture retention curve of laterite soil applied with different treatments

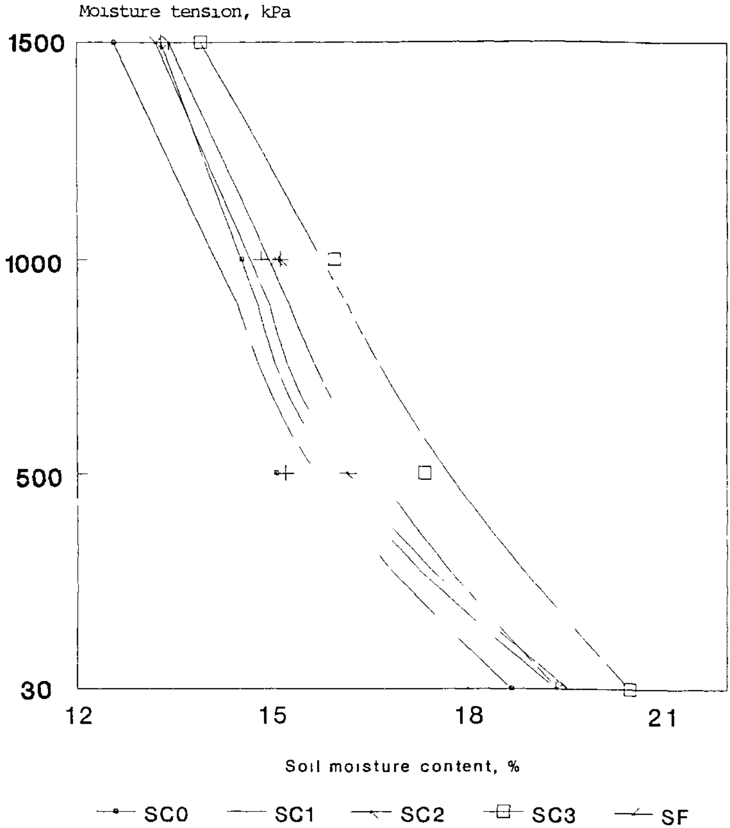
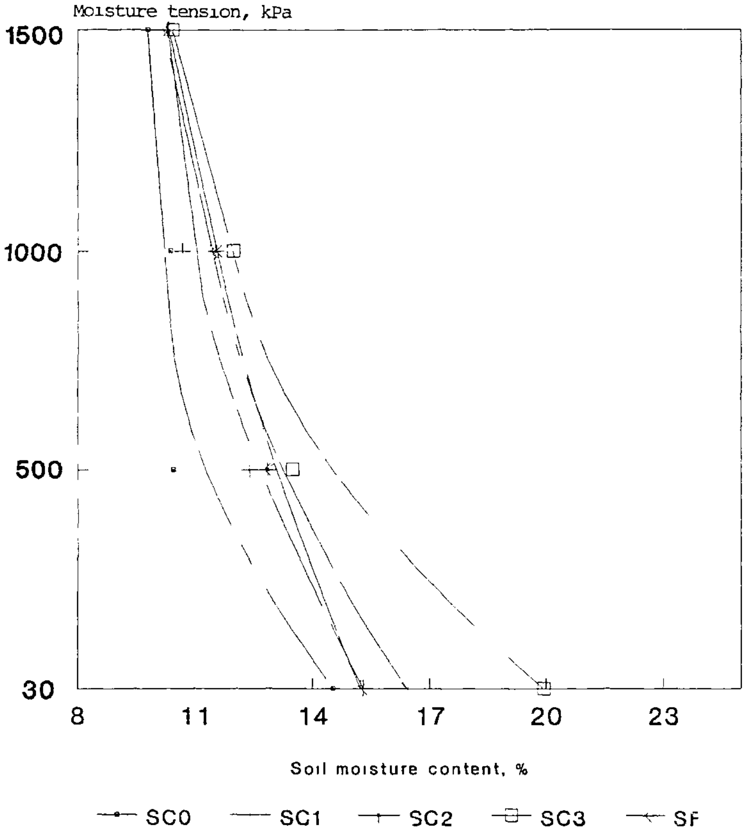


Fig 3 Soil moisture retention curve of red soil applied with different treatments



When the influence of different soil types on moisture retention is taken into consideration, it may be concluded that the inherent physical and structural properties of soil are responsible for high moisture retention Laterite soil has high amount of clay and silt content, low bulk density, high porosity, high pore size distribution, more aggregation and high water holding capacity as compared to red soil and coastal sandy soil So the moisture retention capacity of laterite soil is more when compared to red and coastal sandy soils

Influence of coir pith and FYM on moisture retention is quite evident from the data given above The first and direct effect of these organic materials is due to the high water retention capacities of these material by themselves thus enhancing the soil moisture retention capacity In an indirect manner the modifications in other physical properties by the addition of organic matter also affect the water retention properties of the soil Coir pith and FYM have very high moisture retention power because of their highly carbonaceous nature In addition, these also would serve as soil mulch to prevent evaporationloss of moisture from soil

2 4 Changes in organic carbon content

Changes in organic carbon content at different intervals are given in Table 10 From the table it is evident that different soil types influenced the organic carbon content

Table 10 Effect of soil types, coir pith at different levels and FYM on organic carbon content of soil at different stages of incubation, per cent

Treatments	Sampling interval, month			
	3	6	9	12
Soil types (T)				
S	0 54	0 63	0 59	0 49
L	1 55	1 74	1 66	1 39
R	0 65	0 73	0 69	0 58
SEM±	0 01	0 01	0 011	0 009
CD (0 05)	0 029*	0 029*	0 032*	0 026*
Levels of Coir pith (C)				
C_0	0 77	0 87	0 83	0 69
C_1	0 92	1 03	0 98	0 82
C_2	0 92	1 05	0 99	0 83
C_3	1 04	1 18	1 13	0 94
SEM±	0 012	0 012	0 013	0 010
CD (0 05)	0 034*	0 034*	0 037*	0 030*
Interaction (TxC)				
SC_0	0 52	0 59	0 84	0 46
SC_1	0 50	0 56	0 53	0 44
SC_2	0 51	0 57	0 55	0 46
SC_3	0 63	0 79	0 72	0 60
LC_0	1 26	1 43	1 36	1 14
LC_1	1 63	1 84	1 75	1 47
LC_2	1 59	1 80	1 72	1 44
LC_3	1 70	1 86	1 83	1 53
RC_0	0 52	0 59	0 56	0 47
RC_1	0 63	0 69	0 65	0 55
RC_2	0 67	0 76	0 72	0 60
RC_3	0 79	0 89	0 84	0 70
SEM±	0 02	0 02	0 022	0 02
CD (0 05)	0 058*	0 058*	NS	0 058
Control				
SF	0 54	0 61	0 58	0 48
LF	1 59	1 79	1 70	1 43
RF	0 61	0 69	0 65	0 55
SEM±	0 07	0 08	0 08	0 06
CD* (0 05)	0 202*	0 231*	0 231*	0 173

CD* - CD for comparing control with all other treatment combinations

significantly at all the stages of soil sampling At the 3rd month of incubation, laterite soil recorded the highest value of organic carbon (1 55%) and the coastal sandy soil, the lowest (0 54%) Red soil recorded a value in between these two (0 65%) The same trend was followed at other stages also

There was significant difference in organic carbon content at all the stages of incubation which was influenced by different levels of coir pith As the level of coir pith increased, the organic carbon content also increased At the 3rd month of incubation the highest value was shown by coir pith application at 20 t ha^{-1} (1 04%) and the lowest by no coir pith application (0 77%) From these observations, it is clear that carbonaceous matter is added to the soil by the decomposition of coir pith

Interaction between soil and coir pith also showed significant influence on organic carbon at all stages except the 9th month of incubation At the 3rd month of incubation the highest value was recorded by the treatment combination LC_3 (1 70%) and the lowest by SC_1 (0 50%) The same trend was followed in other stages of incubation also

Control treatments also showed significant influence on organic carbon content at all stages Laterite soil applied with FYM (LF) showed the highest value (1 59%) and coastal sandy soil with FYM (SF) showed the lowest value (0 54%) The same trend was recorded in other stages also The control treatment SF was found to be on par with SC_0, SC_1, SC_2 and SC_3 in all stages of incubation The treatment LF was on par with LC_1, LC_2 and LC_3 and superior to LC_0 (1 26%) at the third month of incubation The same pattern was followed at the 6th, 9th and 12th month of incubation The treatment RF was found to be on par with RC_0, RC_1, RC_2 and RC_3 at all stages of incubation

In all the three soil types there was an initial increase in organic carbon content upto a period of six months and then it showed a decreasing trend (Fig 4) In the case of coastal sandy soil, coir pith applied @ 20 t ha^{-1} showed the highest content of organic carbon at different periods It is markedly different from other treatments There is a sharp increase in orgaic carbon content from the 3rd month to the 6th month and then a decrease upto 9th and 12th month of incubation This treatment was found to be closely followed by the FYM application (5 t ha^{-1}) The lowest contents of organic carbon in soil was recorded by coir pith application at the rate of 5 t ha^{-1}

In the case of laterite soil also coir pith application @ 20 t ha^{-1} showed the highest values followed by coir pith @ 10 t ha^{-1}, 15 t ha^{-1}, FYM (5 t ha^{-1}) and the lowest by absolute control Coir pith application at different levels recorded values which vary within a range of 0 10 to 0 15 per cent (Fig 5)

Fig. 4. Organic carbon content at different periods of incubation in coastal sandy soil

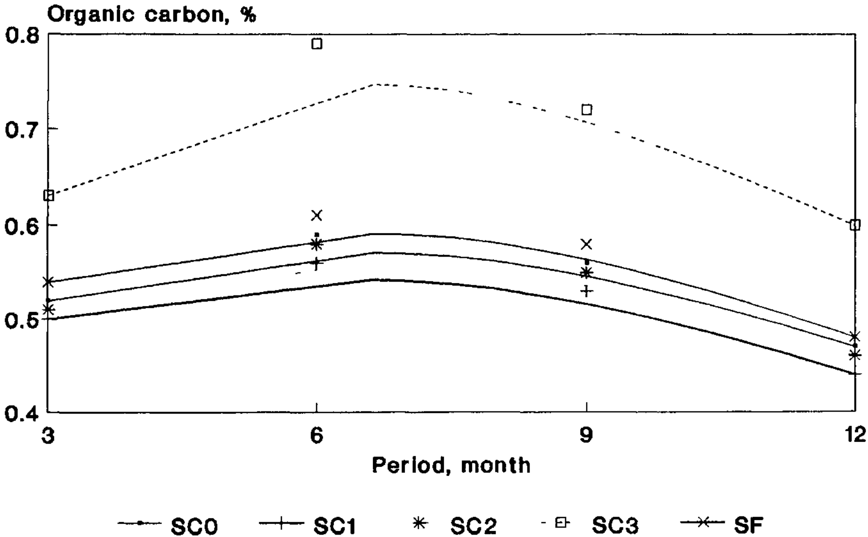


Fig.5. Organic carbon content at different periods of incubation in laterite soil

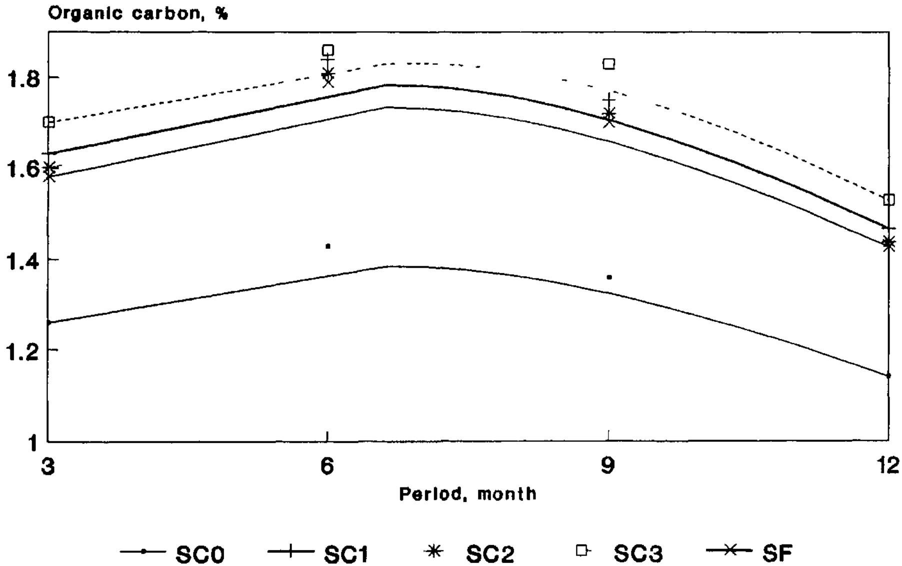
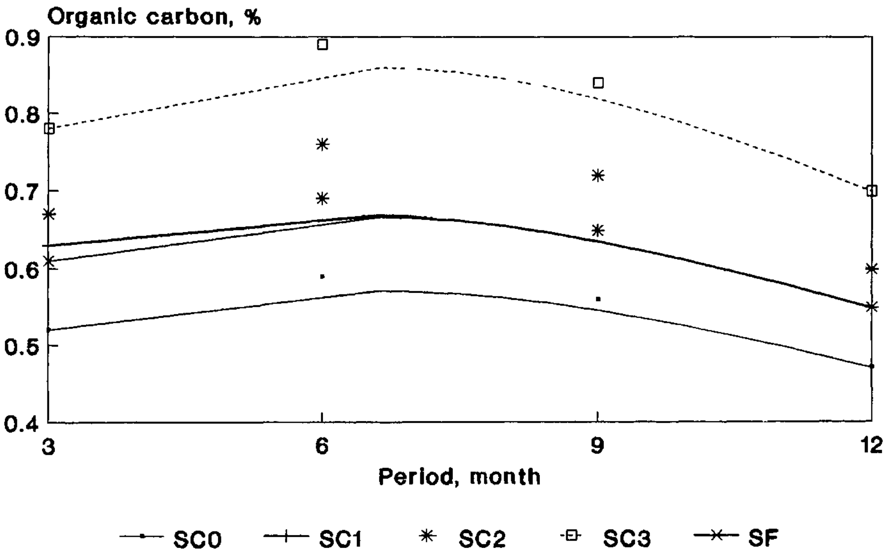


Fig. 6. Organic carbon content at different periods of incubation in red soil



For red soil the values are more or less distributed within a range of 0 47 to 0 89 The highest values were recorded by coir pith @ 20 t ha^{1} followed 10 t ha^{1}, 5 t ha^{1} FYM (5 t ha^{1}) and the lowest by absolute control (Fig 6)

The initial increase upto a period of six months and the decrease afterwards may be due to the fast degradation of refractory organic compounds in the coir pith and FYM by the increased activity of microbes This observation is in conformity with Nambiar (1988)

2 5 **Changes in cation exchange capacity (CEC)**

Changes in CEC at the end of one year are given in Table 11 It is observed that different soil types had significant influence on CEC The highest value was given by laterite soil (10 51 cmol (+) kg^{1}) and the lowest by red soil (4 47 cmol (+) kg^{1}) Different levels of coir pith also showed significant influence on CEC The value of CEC increased as the level of coir pith increased The lowest value was showed by C_0 (6 24 cmol (+) kg^{1}) and the highest by C_3 (8 00).

Interactions between soil and coir pith influenced the CEC of different soil types significantly It is clear that SC_3 recorded the highest value (6 96 cmol (+) kg^{1}) and SC_0 showed the lowest value (5 24 cmol (+) kg^{1}) for coastal sandy soil For laterite soil the interaction LC_0 registered the lowest

Table 11 Effect of soil types, coir pith at different levels and FYM on cation exchange capacity after incubation, cmol (+) kg $^{-1}$

Treatments	Means
Soil types (T)	
S	5 89
L	10 51
R	4 47
SEM±	0 048
CD (0 05)	0 137*
Levels of Coir pith (C)	
C_0	6 24
C_1	6 66
C_2	6 90
C_3	8 00
SEM±	0 055
CD (0 05)	0 158*
Interaction (TxC)	
SC_0	5 24
SC_1	5 49
SC_2	5 86
SC_3	6 96
LC_0	9 54
LC_1	10 23
LC_2	10 47
LC_3	11 79
RC_0	4 02
RC_1	4 25
RC_2	4 36
RC_3	5 25
SEM±	0 095
CD (0 05)	0 194*
Control	
SF	5 74
LF	10 56
RF	4 22
SEM±	0 40
CD* (0 05)	NS

CD* - CD for comparing control with all other treatment combinations

value (9 54 cmol (+) kg^{-1}) and LC_3 the highest (11 79 cmol (+) kg^{-1}) As far as red soil was considered RC_0 the lowest value (4 02 cmol (+) kg^{-1}) and RC_3 the highest (5 25 cmol (+) kg^{-1}) It is very clear from the data that CEC showed an increasing tendency when the level of coir pith increased and coir pith application @ 20 t ha^{-1} gave the best result

Control treatments also showed no significant influence on CEC However the treatment RF registered the lowest value (4 22 cmol (+) kg^{-1}) and LF recorded the highest value (10 56 cmol (+) kg^{-1})

3. Experiment No.2

Results obtained from the in vitro study are described and discussed below

3 1 Growth parameters

Plant height at the age of one month and six months are given in Table 12 It was found that soil types did not influence the plant height significantly Levels of coir pith also had no significant effect on plant height Interaction between soil and coir pith had not significantly influenced the plant height Soils treated with FYM also showed no significant influence on plant height

Table 12 Effect of soil types, coir pith at different levels and FYM on plant height, cm

Treatments	First month	Sixth month
Soil types (T)		
S	17 88	36 53
L	17 30	47 55
R	19 17	40 86
SEM±	0 541	2 634
CD (0 05)	NS	NS
Levels of Coir pith (C)		
C_0	18 47	43 28
C_1	18 94	41 90
C_2	17 18	40 19
C_3	17 89	41 22
SEM±	0 624	3 042
CD (0 05)	NS	NS
Interaction (TxC)		
SC_0	18 40	38 67
SC	19 03	34 63
SC_2	16 93	39 10
SC_3	17 17	33 73
LC_0	17 46	51 67
LC_1	18 80	48 90
LC_2	16 13	42 93
LC_3	16 80	46 70
RC_0	19 53	39 50
RC_1	19 00	42 17
RC_2	18 47	38 53
RC_3	19 70	43 23
SEM±	1 08	5 27
CD (0 05)	NS	NS
Control		
SF	15 20	34 77
LF	19 33	63 63
RF	18 17	36 23
SEM±	0 32	1 54
CD*(0 05)	NS	NS

CD* - CD for comparing control with all other treatment combinations

Table 13 Effect of soil types, coir pith at different levels and FYM on plant girth, cm

Treatments	First month	Sixth month
Soil types (T)		
S	2 04	4 06
L	2 00	4 19
R	1 96	3 78
SEM±	0 097	0 144
CD (0 05)	NS	NS
Levels of Coir pith (C)		
C_0	1 96	3 76
C_1	1 99	4 03
C_2	2 00	4 26
C_3	2 04	4 00
SEM±	1 124	0 167
CD (0 05)	NS	NS
Interaction (TxC)		
SC_0	1 85	3 77
SC_1	2 10	3 77
SC_2	2 13	4 40
SC_3	2 07	4 30
LC_0	2 03	4 20
LC_1	1 90	4 00
LC_2	2 00	4 33
LC_3	2 07	4 23
RC_0	2 00	3 30
RC_1	1 98	4 33
RC_2	1 87	4 03
RC_3	2 00	3 47
SEM±	0 195	0 289
CD (0 05)	NS	NS
Control		
SF	2 03	4 40
LF	2 07	5 63
RF	1 93	3 73
SEM±	0 04	0 10
CD* (0 05)	NS	NS

CD* - CD for comparing control with all other treatment combinations

Table 14 Effect of soil types, coir pith at different levels and FYM on total number of leaves

Treatments	First month	Sixth month
Soil types (T)		
S	10 92	26 83
L	10 83	22 75
R	8 67	17 00
SEM±	0 750	2 54
CD (0 05)	NS	NS
Levels of Coir pith (C)		
C_0	9 78	17 44
C_1	10 67	22 89
C_2	9 67	21 56
C_3	10 44	26 89
SEM±	0 866	2 94
CD (0 05)	NS	NS
Interaction (TxC)		
SC_0	11 67	22 67
SC	10 00	25 67
SC_2	10 33	24 00
SC_3	11 67	35 00
LC_0	9 00	14 67
LC_1	13 00	20 33
LC_2	10 67	26 67
LC	10 67	29 33
RC_0	8 67	15 00
RC	9 00	22 67
RC_2	8 00	14 00
RC_3	9 00	16 33
SEM±	1 50	5 09
CD (0 05)	NS	NS
Control		
SF	13 00	30 33
LF	10 67	38 00
RF	8 67	13 00
SEM±	0 39	1 51
CD*(0 05)	NS	NS

CD* - CD for comparing control with all other treatment combinations

Changes in plant girth at the age of one month and six months are given in Table 13 Soil types and levels of coir pith had not influenced plant girth significantly Soil coir pith interaction and soil FYM combinations were not found to be significantly affecting the plant girth

Soil types levels of coir pith and soil coir pith interaction were not influencing the total number of leaves significantly (Table 14) The control treatments in soils treated with FYM were also not showing significantly different values

3 2 Water used for irrigation

Mean values of total quantity of water used for irrigation and average of intervals taken between each irrigation are given in Table 15 In the case of coastal sandy soil the treatment SC_0 showed the highest intake of water (230 64 l) and SC_3 recorded the lowest (137 64 l) A clear trend of decrease in the quantity of water used for irrigation with increase in the levels of coir pith was observed The treatment SF recorded a water utilization value of 177 32 l which is almost equal to the values recorded by SC and SC_2 For laterite soil also similar trend was followed with LC_0 registering a value 249 00 l and LC_3 recording a value of 205 92 l Here also LF registered a value (247 52 l) which is comparable to LC and LC_2 For red soil same trend was followed with RC_0 giving a value of 261 63 l RC_3 recording the lowest

Table 15 Mean values of total quantity of water used for irrigation and average interval of irrigation for a period of six months

Treatments	Quantity of water used for irrigation, l	Average interval between two irrigations h
SC_0	230 64	28 0
SC	179 80	32 7
SC_2	178 56	32 7
SC	137 64	45 9
SF	177 32	33 0
LC_0	249 00	40 3
LC_1	247 52	40 7
LC_2	245 44	41 1
LC_3	205 92	48 8
LF	247 52	40 7
RC_0	261 63	32 0
RC_1	242 82	33 6
RC_2	242 82	34 0
RC_3	200 07	40 3
RF	227 43	35 1

value of 200 07 l and RF registering a value of 227 43 l But both RC_1 and RC_2 recorded a value of 242 82 l which was higher than that of RF From these observations we can arrive at a conclusion that there was considerable decrease in water consumption with the addition of coir pith and FYM and coir pith application @ 20 t ha^{1} gave the best result

When the intervals between consecutive irrigations were considered we could observe that interval between irrigations can be increased by the application of increasing levels of coir pith In the case of coastal sandy soil SC_0 recorded a value of 28 hrs which was the shortest interval and the longest by SC_3 (45 9 h) The treatments SC_1 SC_2 and SF recorded almost equal values For laterite soil also LC_3 registered the longest interval (48 8 h) and the shortest by LC_0 (40 3 h Other treatments recorded almost same values For red soil also the trend was found to be the same The treatment RC_3 offered the longest interval (40 3 h) and RC_0 the shortest (32 0 h) The treatment RF recorded a higher value (35 1 h) than RC_1 (33 6 h) and RC_2 (34 0 h) Here also we could observe that as the level of coir pith increased the interval between consecutive irrigations increased From these findings, we can conclude that coir pith can retain more water in the soil irrespective of the soil types

3 3 Available N, P and K after the experiment

Values of available N, P and K are given in Table 16

3 3 1 Available N

Soil types were found to be influencing significantly on available N The highest value was given by laterite soil (205 86 kg ha $^{-1}$) and the lowest by coastal sandy soil (90 46kg ha $^{-1}$) For the red soil the available N content was recorded as 187 28 kg ha $^{-1}$

There was significant difference in available N by the application of different levels of coir pith As the level of coir pith increased the amount of available N decreased The lowest value of available N was given by coir pith application @ 20 t ha $^{-1}$ (154 19 kg ha $^{-1}$) and the highest was given by no coir pith application (173 96 kg ha $^{-1}$) The available N decreased after a period of 6 months The low amount of nitrogen in coir pith resulted in the wider range of C/N ratio of coir pith The decrease in available N is probably due to the immobilization of a fraction of available N as organically bound form When the level of coir pith increased there may be higher degree of immobilization This results are in conformity with the observations made by Nambiar *et al* (1988)

Table 16 Effect of soil types, coir pith at different levels and FYM on available N, P and K contents of soil used for *in vitro* study after six months, kg ha[1]

Treatments	Available N	Available P	Available K
Soil types (T)			
S	90 46	24 32	120 63
L	205 86	32 34	230 31
R	187 28	11 09	112 56
SEM±	0 786	0 199	3 004
CD (0 05)	2 269*	0 574*	8 672*
Levels of Coir pith (C)			
C_0	173 96	19 85	130 84
C_1	158 83	22 46	150 07
C_2	157 82	22 90	162 92
C_3	154 19	25 14	174 17
SEM±	0 907	0 23	3 47
CD (0 05)	2 618*	0 664*	10 015*
Interaction (TxC)			
SC_0	93 30	22 39	100 60
SC	90 99	23 68	116 07
SC_2	89 99	24 52	125 50
SC_3	87 54	26 71	140 37
LC_0	221 04	28 32	213 00
LC_1	202 83	32 77	220 23
LC_2	201 74	32 51	238 07
LC_3	197 82	35 75	249 93
RC_0	207 55	8 85	78 93
RC	182 65	10 91	113 90
RC_2	181 73	11 67	125 20
RC_3	177 20	12 97	132 20
SEM±	1 57	0 40	
CD (0 05)	4 53*	NS	NS
Control			
SF	92 07	23 91	113 4
LF	207 03	32 67	223 7
RF	184 76	11 63	108 40
SEM±	7 70	1 35	8 48
CD* (0 05)	22 23*	3 89*	24 48*

CD* - CD for comparing control with all other treatment combinations

Interactions between soil and coir pith also had significant effect on available N The highest value was given by laterite soil with no coir pith pith application (221 04 kg ha^{1}) and the lowest by coastal sandy soil (87 54 kg ha^{1}) with coir pith application @ 20 t ha^{1}

Soils treated with FYM as a control treatment also showed significant difference in available N The highest value was shown by the treatment combination LF (207 03 kg ha^{1}) and the lowest by SF (92 07 kg ha^{1}) It is due to the variation in the soil types in which FYM was applied

3 3 2 Available P

Different soil types influenced available P significantly Laterite soil showed the highest value 32 34 kg ha) and the lowest value was shown by red soil (11 09kg ha^{1}) The available P content was recorded as 24 32 kg ha^{1} for coastal sandy soil

There was significant difference in the values of available P by the application of different levels of coir pith The quantity of available P was found to be increased with increasing levels of coir pith

Interactions between soil and different levels of coir pith were not found to be significant

The soil treated with FYM also showed significant difference in available P content Soil coir pith interaction and soil FYM combinations were within comparable limits The decomposition of coir pith results in the production of organic acids which causes the release of P from the phosphates of Fe and Al The increase in available P with the application of coir pith and FYM was also due to the addition of P through the organic matter and reduced fixation of P through the chelation of Fe and Al present in the soil These observations are in same line with the findings of Gupta *et al* (1988)

3 3 3 Available K

There was significant difference in the values of available K in different soil types The highest value was given by laterite soil (230 31 kg ha) and the lowest by red soil (112 56 kg ha^{1})

Coir pith application at different levels also showed significant difference in available K content The highest value (174 17 kg ha^{1}) was given by the treatment C_3 and the lowest by C_0 (130 84 kg ha^{1}) The available K content increased with increasing levels of coir pith The increase in available K is due to the addition of K which is present in coir pith after its decomposition and mineralisation

Interactions between different soil types and coir pith were not found to be significant However the effect of soil-FYM combinations were significant due to the differences in the texture of the soil types

3.4 Uptake of N, P and K

Data on uptake of N, P and K are given in Table 17 There was no significant difference for the values of N, P and K uptake for different soil types However the highest value was given by laterite soil and the lowest by coastal sandy soil The values recorded by red soil came in between these two Effect of different levels of coir pith and soil coir pith interaction on the uptake of N were not found to be significant The value of uptake of N in the laterite soil was 0 51 g plant and that of coastal sandy soil was 0 27 g plant Red soil recorded a value of 0 44 g plant^{1} As far as uptake of P is concerned laterite showed the highest value (0 10 g plant^{1}) and the coastal sandy soil the lowest (0 08 g plant) Red soil showed a value of 0 06 g plant^{1} In the case of uptake of K also laterite soil recorded the highest value (0 50 g plant^{1}) and the lowest by coastal sandy soil (0 30 g plant^{1}) Red soil recorded a value of 0 39 g plant^{1} which came in between the values recorded by laterite and coastal sandy soils

As the level of coir pith increased the values of uptake for N, P and K also increased Coir pith applied @ 20 t ha^{1} recorded the values of 0 47 kg ha^{1}, 0 08 kg ha^{1} and

Table 17 Effect of soil types, coir pith at different levels and FYM on uptake of N, P and K by cocoa seedlings, g plant^{1}

Treatments	N	P	K
Soil types (S)			
S	0 27	0 08	0 30
L	0 51	0 10	0 50
R	0 44	0 06	0 39
SEM±	0 036	0 022	0 036
CD (0 05)	NS	NS	NS
Levels of Coir pith (C)			
C_0	0 39	0 11	0 41
C_1	0 34	0 07	0 30
C_2	0 43	0 05	0 40
C_3	0 47	0 08	0 43
SEM±	0 041	0 026	0 041
CD (0 05)	NS	NS	NS
Interaction (TxC)			
SC_0	0 30	0 08	0 32
SC_1	0 23	0 08	0 27
SC_2	0 26	0 06	0 35
SC_3	0 29	0 09	0 35
LC_0	0 51	0 19	0 56
LC_1	0 46	0 07	0 47
LC_2	0 50	0 05	0 45
LC_3	0 57	0 06	0 51
RC_0	0 36	0 04	0 36
RC	0 32	0 06	0 36
RC_2	0 52	0 05	0 40
RC_3	0 55	0 07	0 42
SEM±	0 072	0 044	0 071
CD (0 05)	NS	NS	NS
Control			
SF	0 33	0 07	0 33
LF	0 96	0 09	0 89
RF	0 44	0 05	0 34
SEM±	0 03	0 01	0 03
CD*(0 05)	NS	NS	NS

CD* - CD for comparing control with all other treatment combinations

0 43 kg ha of N P and K respectively and no coir pith application registered the values of 0 39 0 11 and 0 41 kg ha of N P and K respectively Soil coir pith interaction and soil FYM combinations were not found to be influencing the uptake of N, P and K significantly

4. Relationship between organic carbon content and various physical properties of different soil groups

Studies were also conducted to know the possible relationship between organic carbon content and the various physical properties of the three soil types The relevant linear regression equations and linear correlation coefficients are described in Table 18 All the correlation coefficients except those representing the relationship of organic carbon with per cent pore space per cent aggregate stability mean weight diameter, stability index and structural coefficient in laterite soil were found to be statistically significant

An increase inorganic carbon content resulted in a significant decline in bulk density in all the three soil types Among these soil types red soil explained the strongest relationship between organic carbon content and bulk density Coastal sandy soil showed the maximum rate of increase with regard to such soil parameters as maximum water holding capacity, stability index and structural coefficient The rates of change of per cent pore space, per cent aggregate stability and mean weight diameter were maximum for red soil compared to other soil types Laterite soil showed least response to organic carbon content with respect to properties like per cent pore space, per cent aggregate stability, mean weight diameter stability index and structural coefficient

Table 18 Relationship between organic carbon content (X) and physical properties (Yi+) of different soil groups

Yi	Coastal sandy		Laterite		Red	
	Regression equation	Correlation coefficient	Regression equation	Correlation coefficient	Regression equation	Correlation coefficient
1 Bulk density (Y_1)	Y_1 1 79 0 33 X**	0 788**	Y_1 1 42 0 097 X**	0 820**	Y_1 1 47 0 212 X**	0 843**
2 Maximum water holding capacity (Y_2)	Y_2 10 13+27 57 X**	0 909**	Y_2 29 92+8 68 X**	0 731**	Y_2 24 34+15 97 X**	0 714**
3 Per cent pore space (Y_3)	Y_3 24 88+17 57 X**	0 826**	Y_3 40 43+4 60 X	0 380	Y_3 34 83+12 21 X**	0 873**
4 Per cent aggregate stability (Y_4)	Y_4 23 38+32 70 X*	0 859*	Y_4 24 .5+14 92 X	0 592	Y_4 10 12+44 84 X*	0 910*
5 Mean weight diametr (Y_5)	Y_5 0 37+0 43 X*	0 902*	Y_5 0 74+0 32 X	0 547	Y_5 0 67+0 63 X*	0 914*
6 Stability index (Y_6)	Y_6 21 60+25 13 X**	0 956**	Y_6 25 64+13 63 X	0 642	Y_6 27 65+14 03 X**	0 952**
7 Structural coefficient (Y_7)	Y_7 0 04+0 734 X*	0 928*	Y_7 0 16+0 23 X	0 497	Y_7 0 10+0 788 X*	0 920*

+ denotes the serial number of the physical properties i 1, 2, 3 5, 6 and 7

* Significant at 5 per cent level ** Significant at 1 per cent level

Summary

SUMMARY

The study on the effect of coir pith on physico-chemical and moisture retention properties of selected soil groups of Kerala was conducted during the period 1991-93 at the College of Horticulture, Vellanikkara to evaluate the changes in physical and chemical properties of three major soil groups of Kerala viz coastal sandy, laterite and red soils In order to study the major physico-chemical properties of these three soil types as influenced by the application of different levels of coir pith, an incubation study was conducted for a period of one year, and to evaluate the water retention property of coir pith an *in vitro* study was carried out for a period of six months using cocoa seedlings as the indicator plant The salient features of the results are summarized below

1 The volume-mass relationships of the three soil types were significantly influenced by the addition of coir pith Bulk density decreased progressively with the addition of increasing levels of coir pith Maximum water holding capacity and per cent pore space also showed a significant increase with the addition of coir pith

2 Soil moisture retention at tensions of 30, 500, 1000 and 1500 kPa were studied Coir pith application

significantly influenced the moisture retention capacity of all the soil groups under study

3 Water stable aggregates at the end of one year after incubation were estimated Four parameters namely per cent aggregate stability, mean weight diameter structural coefficient and stability index were found out There was significant improvement in these properties with the addition of coir pith

4 Due to the application of coir pith at different levels and FYM, there was an initial increase in organic carbon content for all the soil types for a period of six months and then a gradual decrease

5 Cation exchange capacity of all the soil groups was significantly improved by the addition of coir pith at different levels

6 Total quantities of water used for irrigating pots treated with different levels of coir pith were measured As the level of coir pith increased, the quantity of water used for irrigation decreased

7 Frequency of irrigation for different treatments were found to be decreased with increasing levels of coir pith

8 For different soil types the available nitrogen content was found to be decreasing with increasing levels of coir pith Available phosphorus and potassium contents of the soils increased with increasing levels of coir pith

9 Uptake of nitrogen, phosphorus and potassium by the cocoa seedlings was not influenced significantly with the application of coir pith

10 Significant correlation was found out between soil physical properties and organic carbon content for all the soil groups selected for the study

References

REFERENCES

Angers, D A 1992 Changes in soil aggregation and organic carbon under corn and alfalfa *Soil Sci Soc Am. J* **56** 1244-1249

Bauer, A and Black, A L 1992 Organic carbon effects on available water capacity of three soil textural groups *Soil Sci. Soc Am J* **56** 248-254

Biswas, T D , Jain, B L and Mandal, S C 1971 Cumulative effect of different levels of manures on the physical properties of soil *J Indian Soc Soil Sci* **19** 31-37

Chakrabarti, G , Banerjee, S K and Gupta, S K 1979 Molecular weights and total activities of humic acids extracted from soil aggregates of different sizes *J Indian Soc Soil Sci* **27** 129-132

Chakraborti, D C 1971 Investigation on erodibility and water stable aggregates of certain soils of eastern Nephal *J Indian Soc Soil Sci* **19** 441-446

Dinel, H , Mathur, S P and Levesque, M 1991 Improvements of physical properties of degraded shallow organic soils by admixing organic overlays and mineral sublayers *Can J Soil Sci.* **71** 101-117

Gopalaswamy, A , Rajkannan, B , Poongothai, S and Natesan, R 1991 Efficacy of coir dust in comparison with pressmud and groundnut husk on physical properties of soil *Proc Seminar on Utilisation of Coir pith in Agriculture* Tail Nadu Agrl Univ , Coimbatore, p 151-156

Gupta, R N and Narin, B 1971 Investigation on some physical properties of alluvial soils of Uttar Pradesh related to conservation and management *J Indian Soc Soil Sci* 19 11-22

Gupta, A P , Antil, R S and Narwal, R P 1988 Effect of farm yard manure on organic carbon, available nitrogen and phosphorus content of soil during different periods of wheat growth *J Indian Soc Soil Sci* 18 45-50

Havanagi , G V and Mann 1970 Effect of rotations and continuous application of manures and fertilizers on soil properties under dry farming condition *J Indian Soc Soil Sci* 18 45-50

Hollis, J M , Jones, R J A and Palmer, K C 1977 The effect of organic matter and particle size on the water retention properties of some soils in west midlands of England *Geoderma* 17 225-238

Jackson, M L 1958 *Soil Chemical Analysis* Prentice-Hall Inc , London, p 82-110

Jackson, M L 1969 *Soil Chemical Analysis - Advanced Course* 2nd ed , L B Publishers and Distributors (P) Ltd , Bangalore, p 252-286

Kanwar, J S and Prihar, S S 1962 Effect of continuous application of manures and fertilizers on some physical properties of Punjab soils *J Indian Soc Soil Sci* **10** 243 247

Kaushik, R D , Verma, K S , Dang, Y P , Sharma, A P , Varma, S L and Pannu, B S 1984 Effect of nitrogen and farmyard manure on yield of crops, nutrient uptake and soil fertility in paddy - wheat rotation *Indian J agric Res* **18** 73-78

Keen, B A and Raczkowski, H J 1921 Relationship between clay content and certain physical properties of soils *J agric Sci Camb* **11** 441-449

Kurumthottical, S T 1982 Dynamics and residual effects of permanent manurial experiment on rice M Sc (Ag) thesis, Kerala Agrl Univ , Thrissur

Leboudi, A E , Ibrahim, S A and Moez, M R 1988 A trial for getting benefit from organic wastes of food industry *Egypt J Soil Sci* **28** 289-298

Loganathan, S 1990 Effect of certain tillage practices and amendments on physico-chemical properties of problem soils *Madras agric J* **77** 204-208

Loganathan, S and Lakshminarasimhan, C R 1979 Physical properties of soil and yield of ground nut as influenced by application of amendments to soils *Madras agric J* 66 687-689

Loyonet, G I 1977 Interaction between water relations, organic matter and amorphous substances in soils on basaltic materials in a humid tropical climate *Agronomic Tropicale* 32 115-120

Mahimairaja, S , Helkiah, J and Gopalaswamy, A 1986 Long term effects of graded doses of fertilizers and manures on soil physical condition *Madras agric J* 73 340-347

Maskina, M S , Singh, Y and Singh, B 1988 Response of wet land rice to fertilizer nitrogen in a soil amended with cattle, poultry and pig manures *Biological Wastes* 26 1-8

Maurya, P R and Ghosh, A B 1972 Effect of long term manuring and rotational cropping on fertility status of alluvial calcarious soil *J Indian Soc Soil Sci* 20 31-43

Mayalagu, K 1983 Influence of different soil amendments on the physical properties of a heavy black soil and yield of ground nut TMV-7 in the Periyar-Vaigai command area *Madras agric J* 70 304-308

*Mello, F A F , Silveira, R I , Arzolla, S and Hellmeister, S R 1978 Effect of organic matter on the moisture retention capacity of four soils of the Piracicaba, Brazil *Lucide Queiroz* 35 45-50

Mohsin, M A and Syeedullah, M 1981 Influence of texture and organic carbon on available moisture of soils *Rajendra agric Univ J Res* 3 1-12

Muthuvel, P , Kandaswamy, P and Krishnamoorthy, K K 1977 Availability of NPK under long term fertilization *Madras agric J* 64 358-362

Nambiar, C K B , Biddappa, C C and Khan, H H 1988 Effect of coir dust blended fertilizers on carbon and nitrogen changes in a coastal sandy soil *J Plantation Crops* 16 100-104

N'dayegamiye, A and Angers, D A 1993 Organic matter characteristics and water stable aggregation of a sandy loam soil after 9 years of wood-residue application *Can J Soil Sci* 73 1115-1122

N'dayegamiye, A and Cote, D 1989 Effect of long term pig slurry and solid cattle manure application on soil chemical and biological properties *Can J Soil Sci* 67 39-47

Orphanos, P I and Stylianov, Y 1980 The soil moisture characteristics of a terra rosa loamy soil Agricultural Research Inst Cyprus Technical Paper **19** 19 22

Pagliai, M , Lamarca, M and Lucamonte, G 1987 Changes in soil porosity in remolded soils treated with poultry manure *Soil Sci* **144** 128 183

Panse, V G and Sukhatme, P V 1985 *Statistical Methods for Agricultural Workers* 4th edn ICAR, New Delhi, p 347

Piper, C S 1942 *Soil and Plant Analysis* Hans Publishers, Bombay p 368

Prameela, K P 1983 Studies on the moisture retention characteristics of alluvial soils of Kerala M Sc (Ag) thesis, Kerala Agric Univ , Thrissur

Prasad, B and Singh, A P 1980 Changes in soil properties with long term use of fertilizers, lime and farmyard manure *J Indian Soc Soil Sci* **28** 465-468

Ramaswamy, P P 1979 Economic recycling of crop residues for soil fertility improvement *Madras agric J* **66** 737 743

Ramaswamy, P P and Kothandaraman, G U 1991 Drought management using agro-industrial wastes *Proc Seminar on Utilisation of Coir Pith in Agriculture* Tamil Nadu Agrl Univ , Coimbatore p 83-90

Rasiah, V , Kay, B D and Martin, T 1992 Variation of structural stability with water content Influence of selected soil properties *Soil Sci Soc Am J* **56** 1604-1609

Ravikumar, V and Krishnamoorthy, K K 1986 Effect of soil amendments on the chemical properties of Vertisol and yield of finger millet *Madras agric J* **67** 369-374

Richards, L A 1947 Pressure membrane apparatus, construction and use *Agri. Engg* **28** 451-454

*Riley, H C F 1979 Relationship between soil moisture holding properties and soil texture, organic matter content and bulk density *Forskning og Forski Lendbruchet* **30** 379-398

Santhi, R , Jeyaraman, S , Mayalagu, K and Gopalaswamy, A 1991 Efficacy of composted coir pith with different levels of inorganic N on nutrient availability and uptake by rice *Proc Seminar on Utilisation of Coir pith in Agriculture* Tamil Nadu Agrl Univ , Coimbatore, p 27-34

Sharma, H L , Singh, C M and Modgal, S C 1987 Use of organics in rice-wheat crop sequence *Indian J agric Sci* **57** 163-168

Sharma, N , Srivastava, L L , Mishra, B and Srivastava, N C 1988 Changes in some physico-chemical properties of an acid red soil as affected by long term fertilizers and amendments *J Indian Soc Soil Sci* **36** 688-692

Singaram, P and Pothiraj, P 1991 Coir pith - An amendment for tannery polluted soils *Proc Seminar on Utilisation of Coir pith in Agriculture* Tamil NaduAgrl Univ , Coimbatore, p 118-121

Singh, B , Sharma, K N , Rana, D S , Sodhi, S S and Kapur, M L 1983 Available phosphorus, potassium and soil organic matter content as influenced by long term application of fertilizers and farmyard manure to wheat-maize rotation *J Indian Soc Soil Sci* **31** 491-494

Sinha, N P , Prasad, B and Ghosh, A B 1980 Soil physical properties an influenced by long term use of chemical fertilizers under intensive cropping *J Indian Soc Soil Sci* **28** 516-518

Snedecor, G W and Cochran, W G 1967 *Statiscal Methods* 6th ed Oxford and IBH Pub Co , Calcutta, p 593

Soong, N K 1980 Influence of soil organic matter on aggregation of soils in peninsular Malaysia *J Rubb Res Inst Malaysia* **28** 32-46

Stevenson, F J 1982 Organic matter and nutrient availability Nonsymbiotic N_2 fixation and organic matter in the tropics - Symposia Paper *12th International Congress of Soil Science*, New Delhi p 137

Subbiah, B V and Asija, G L 1956 A rapid procedure for estimation of available nitrogen in soils *Curr Sci* **29** 259-260

Subramanian, S , Loganathan, S , Ravikumar, V and Krishnamoorthy, K K 1975 Effect of tillage and organic amendments on the physical properties of soil and yield of bajra *Madras agric J* **62** 106-109

Thiyagarajan, T M 1978 Physico-chemical appraisal of selected soil profiles M Sc (Ag) thesis, Tamil Nadu Agrl Univ , Coimbatore

Thompson, M L , Zhang, H , Kazemi, M and Sandor, J A 1989 Contribution of organic matter to cation exchange capacity and specific surface area of fractionated soil materials *Soil Sci* **148** 250-256

Thulasidharan, C 1983 Studies on the moisture retention characteristics of laterite soils of Kerala M Sc (Ag) thesis, Kerala Agric Univ , Thrissur

Veerabadran, V 1991 Coir pith application and yield of rainfed millets in red soil 1991 Coir pith application and yield of rainfed millets in red soil *Proc Seminar on Utilisation of Coir pith in Agriculture* Tamil Nadu Agrl Univ , Combatore, p 91-99

Yadav, J S P and Singh, K 1976 Effect of forest plantation on water stable aggregates of soil *J Indian Soc Soil Sci* 24 363-368

Yoder, R E 1936 A direct method of aggregate analysis of soils and study of the physical nature of erosion loses *J Am Soc Agron* 28 337-351

Zusevic, J A 1980 Seasonal changes of permanent wilting point in some selected tropical soils *Commun on Soil Sci Pl Anal* 11 843-850

* Original not seen

Appendices

APPENDIX-I

Profile description of Manathala Series

Typical profile

Horizon	Depth (cm)	Description
A_p	0-37	Dark brown (10 YR 3/3) moist, loamy sand, single grained, non-sticky, non-plastic, very friable, pores few, few quartz, few fine roots, clear wavy boundary
A_{21}	37-121	Brownish yellow (10 YR 6/8) moist, loamy sand, non-sticky, and non-plastic, single grained, massive, moist, very friable, pores absent, few quartz, few oyster shells, many coarse roots

APPENDIX-II

Profile description of Vellanikkara Series

Horizon	Depth (cm)	Description
A_p	0-8	Reddish brown (5 YR 4/4), clay loam, medium, moderate, subangular blocky structures, firm, slightly sticky and slightly plastic, plentiful roots, minute quartz gravels present, clear smooth boundary, moderate permeability
B_{21}	8-23	Dark reddish grey (5 YR 4/2), clay loam, moderately medium, sub-angular, blocky structure, firm, slightly sticky and slightly plastic, plentiful roots, minute quartz gravels present, clear, smooth boundary, moderate permeability
B_{22}	23-120	Yellowish red (5 YR 4/6) silty clay, strong coarse sub-angular blocky structure, firm, sticky and plastic, few fine roots, minute quartz gravels, moderate slow permeability

APPENDIX-III

Profile description of Vellayani Series

Horizon	Depth (cm)	Description
A_p	0-19	Red (2 5 YR 4/6) sandy loam medium week granular, very friable, slightly sticky and slightly plastic, plentiful fine roots, moderately rapid permeability, clear smooth boundary
B_{21}	19-76	Dark red (2 5 YR 3/6) sandy loam weak, fine to medium sub-angular blocky friable Slightly sticky and slightly plastic, plentiful fine to medium roots, moderately rapid permeability, gradual smooth boundary
B_{22}	76-150+	Dark red (2 5 YR 3/6), sandy clay moderate coarse sub-angular blocky, friable, sticky and plastic, few medium roots, moderate permeability

APPENDIX-IV

Chemical composition of coir pith and farmyard manure

	Determination	Mean value	
		Coir pith	FYM
1	Carbon (%)	89 00	12 85
2	Nitrogen (%)	1 03	0 50
3	Phosphorus (%)	0 09	0 20
4	Potassium (%)	1 20	0 50
5	C/N Ratio	86 41	25 70
6	Moisture content (%)	10 84	5 64

EFFECT OF COIR PITH ON PHYSICO-CHEMICAL AND MOISTURE RETENTION PROPERTIES OF SELECTED SOIL GROUPS OF KERALA

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ABSTRACT

An investigation on the effect of coir pith on physico-chemical and moisture retention properties of selected soil groups of Kerala was carried out at the Department of Soil Science and Agricultural Chemistry, College of Horticulture, Vellanikkara, Thrissur during the period 1991-93

Three major soil groups selected for the experiment were coastal sandy, laterite and red Pots were filled with these soils at the rate of 10 kg soil per pot Coir pith at the rate of 5 t ha^{1}, 10 t ha^{1}, and 20 t ha^{1}, was added in the soil An absolute control treatment with no coir pith application and a control treatment with farm yard manure applied at the rate of 5 t ha^{1} were maintained One set of pots was used for incubation study for a period of one year The soils were maintained at field capacity Samples were collected from the pots at quarterly intervals and analysis was done for various physico-chemical properties like volume-mass relationships, moisture retention at tensions of 30, 500, 1000 and 1500 kPa and organic carbon At the end of one year after incubation water stable aggregates and cation exchange capacity were analysed

Another set of pots was used for *in vitro* study Cocoa (*Theobroma cacao* L) seedlings were raised in the pots Irrigation

was given as and when the plant showed temporary wilting symptoms and the interval between the consecutive irrigations was noticed for different treatments At the end of the sixth month the plants were taken out and analysed for nitrogen, phosphorus and potassium and uptake of these nutrients were calculated Soil samples were also collected from the pots to study the available nitrogen, phosphorus and potassium contents

It was noticed that the application of coir pith significantly improved the bulk density, maximum water holding capacity and per cent pore space There was a significant increase in the moisture retention at different tensions Water stable aggregates were measured and per cent aggregate stability, mean weight diameter, structural coefficient and stability index showed significant increase with the increasing levels of coir pith Soil moisture retention at different tensions was significantly influenced by the addition of coir pith As the level of coir pith increased soil moisture retention increased

Organic carbon content showed an initial increase to a period of six months and subsequently decreased Cation exchange capacity showed an increasing tendency with increasing levels of coir pith Significant correlation was obtained between various physical properties and organic carbon content of the soils After the removal of the crop the available nitrogen content of the soil decreased with increasing levels of coir pith whereas available phosphorus and potassium contents increased with increasing levels of coir pith