

Influence of soil texture on nature of mangrove vegetation in Sundarbans Tiger Reserve forest of India

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Abstract— *Quality of bottom soil forms an important component for any kind of mangrove reforestation as well as coastal rehabilitation program. Since textural composition plays an important role in determining the soil quality, a study was undertaken to assess the influence of variations in soil texture on distribution and abundance of different mangrove species across five zones of Sundarbans Tiger Reserve, India. This study showed these mangrove soils to exhibit good occurrences of sand particles. However, the effects of sands on textural quality were frequently masked by moderate occurrence of finer soil particles which rendered the soils to be largely loamy in texture. Such soil conditions favored establishment of mangrove vegetation. Species wise also, mangrove vegetation was found to be more diverse in loam, clay loam, sandy loam and sandy clay loam soil textures respectively while a very few species were observed in clay, sandy clay and silty clay soils.*

Keywords— *Sundarbans Tiger Reserve forest; soil texture; mangrove vegetation; distribution; abundance.*

I. INTRODUCTION

Mangrove forests cover an area of approximately 160,000 km² all over the world, in which the largest forest areas are found in Malaysia, India, Bangladesh, Brazil, Venezuela, Nigeria and Senegal (Giri & Muhlhausen, 2008; Alongi, 2009). Indian Sundarbans falls under the jurisdiction of North 24-Parganas and South 24-Parganas districts in West Bengal comprising of 19 rural blocks covering a total area of 9630 sq. km. Since 1973, about 2585.10 sq. km area of south-eastern part of Sundarbans mangals were declared as Sundarbans Tiger Reserve. This area of Sundarbans Tiger Reserve includes the land area of 1680 sq. km. while the estuarine rivers, creeks and canals cover about 905 sq. km. This entire area under the Sundarbans Tiger Reserve has

been further demarcated as “Core Area” (1330.12 sq. km.) and “Buffer Area” (1255 sq. km.). The Indian Sundarbans is bestowed with the highest floral diversity in the form of mangroves, coastal wetland flora, beach flora, marsh and swamp flora (Chanda, 1977; Naskar & Guhabakshi, 1987; Naskar, 1993; Naskar & Mondal, 1999). Ghosh *et al*, 2003 have reported about 110 plant species to occur in this forest of which about 25 species to be true mangroves. Ghosh, *et al* (2003) also studied on floral diversity of mangroves and mangrove associated species in the Indian Sundarbans. Physico-chemical properties of different mangrove soils in Sundarbans Tiger Reserve have been studied with relation to species diversity (Dasgupta *et al* 2003). Further studies have shown that mangrove soils vary considerably as compared to the non-mangrove soils even in same locations and also with other mangrove soils under different locations with regard to some properties (Dasgupta *et al*, 2018). Patterns of tidal inundation also influence soil characteristics that control species zonation of mangrove forest (Banerjee, 1987; Naidoo, 1980; Saha & Choudhury, 1995). While studying mangrove zonation pattern, several workers have shown that physiological adaptations to such variations may appear to be useful for explaining the observed zonations of mangroves (Smith, 1992, Satyanarayana *et al*, 2002).

II. METHOD

The objective of determining the textural composition of soils is to know the percentage of soil particles contained in different grain size fractions viz. sand, silt and clay and to classify the soils under different textural groups so that the dominant grain sizes present in the soil can be identified easily. The collected soil samples were air dried at a temperature of about 25⁰-30⁰C and relative humidity of about 20%-60% in the laboratory. This was ground with the

help of wooden mortar and soil texture was determined by International pipette method (USDA,1966).

During the first phase of the study, regular collections of soil samples were done from the Indian part of Sundarbans covering 15 blocks of Sundarbans Tiger Reserve and adjoining areas. These blocks were divided into five major zones viz. (i) Eastern Zone (ii) Western Zone (iii) Central Zone (iv) Northern Zone and (v) Southern Zone according to their occurrence (Table -1). Soil samples, collected extensively from different zones, were processed and analyzed for textural composition by following the procedures mentioned above.

During the second phase of the study, the textural composition of rhizosphere soils under different mangrove vegetations were assessed. Twenty three mangrove species commonly occurring in these soil zones were identified and soil samples were collected from their root zones to assess the preferred textural nature of soil required for the specific mangroves for their growth and survival.

III. RESULT AND DISCUSSION

The textural compositions of the mangrove soils in the Indian Sundarbans Tiger Reserve have been presented in Table-1. As observed from the table, the sand particles occurred in high concentrations in most of these soils. However, the direct effects of sands were frequently countered by moderately good occurrence of comparatively finer particles like clay which rendered these soils to be largely loamy in texture. Since mangrove soils occur in intertidal zones and finer soil particles are generally transported to these zones by tidal water, such accumulation of finer particles in such alluviated soils may be expected. Occurrence of these kinds loamy texture may be helpful to maintain a loose soil condition in mangrove soils encouraging good rooting of mangrove vegetation in such soils. In addition, these soils are likely to provide better plant nutrition to the mangroves than the soils which are coarser in texture. In the present study, only two soil zones viz. Pirkhali in northern zone and Mayadwip in southern zone showed clayey soil texture. Although these two zones are situated in almost opposite situations but they have a similarity that both of them are characterized by dense mangrove vegetation. This might have trapped larger amount of finer soil particles from the tidal water which increased the clay content of the soils. Since variations in textural compositions are associated with differences in nutrient status, chemical and physical properties and also the biological properties of soils (Brady, 1980), such changes in textural compositions are likely to influence the

nature of mangrove vegetations under different textural zones.

Textural compositions of rhizosphere soils for different mangrove species commonly found in Sundarbans Tiger Reserve have been presented in Tables 2 to 6. In the present study, species wise occurrence of different mangrove vegetation appeared to be influenced by the soil textural groups. In Table-7, an effort has been made to identify the mangrove species which were found to be associated with different textural sub-groups of the soils. As observed from the table, loamy textures under different subclasses viz. loam, clay loam, sandy loam and sandy clay loam harbored more diverse occurrence of mangrove vegetation while in clay, sandy clay and silty clay textural groups, only a few species of mangroves survived. Since loamy soils constitute a large share of the variations in textural compositions of mangrove soils of Sundarbans, these soils may be, in general, considered to be conducive for good occurrence of diverse mangrove species.

IV. CONCLUSIONS

The study showed that loam and sandy loam soils showed most diverse mangrove species in Indian Sundarbans Tiger Reserve whereas clay, sandy clay and silty clay showed least diversity. Although sand particles often occurred in appreciable concentrations yet the textural composition of these soils were observed to be mostly under different loamy subgroups. This may be due to transportation of finer particles to these estuarine soils through intertidal water.

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Table.1: Textural compositions of the mangrove soils of Sundarbans Tiger Reserve Forest.

Zone	Block	Textural composition (%)		
		Sand	Silt	Clay
Eastern Zone	Arbesi	49.1 41.7-58.5	28.1 25.8-33.5	22.6 7.9-31.5
	Khatuajhuri	41.6 35.1-48.1	27.1 21.1-33.1	31.2 18.7-43.7
	Harinbhanga	44.3 40.6-48.1	26.8 23.6-30.1	28.7 21.7-35.8
Western Zone	Matla	40.7 36.1-46.1	28.1 26.1-32.1	31.0 21.7-37.8
	Netidhopani	41.4 34.8-48.1	26.5 22.9-30.1	31.9 21.7-42.2
	Chottohardi	42.6 36.1-55.7	29.3 26.1-31.0	22.7 14.5-37.7
Northern Zone	Jhilla	49.6 15.0-80.6	23.9 8.2-34.5	32.3 12.5-75.7
	Pirkhali	36.8 25.8-47.8	10.9 0.96-20.9	52.2 51.2-53.2
	Panchmukhani	51.8 29.5-60.5	35.3 30.2-49.2	16.1 1.58-22.0
Central Zone	Chamta	50.2 41.6-59.5	30.8 25.6-36.5	18.8 3.9-32.7

Southern Zone	Chandkhali	50.5 38.1-61.0	29.7 24.5-33.0	19.6 6.0-34.9
	Goasaba	42.9 34.7-55.7	26.2 21.7-36.6	31.2 4.72-42.5
	Bagmara	39.9 26.2-48.2	28.1 23.8-40.2	31.8 14.9-40.3
	Gona	48.2 42.1-55.8	28.3 26.0-29.8	24.0 14.3-29.0
	Mayadwip	35.0 28.1-43.5	25.0 21.4-30.5	39.9 26.0-48.8

Table.2: Textural composition (%) of mangrove rhizosphere soils in eastern zone of Sundarbans Tiger Reserve.

Sp. Name	Eastern Zone								
	Arbesi			Khatuajhuri			Harinbhangha		
	Sand	Silt	Clay	Sand	Silt	Clay	Sand	Silt	Clay
<i>Rhizophora mucronata</i> Lamk	35.7	27.3	29.3	60.7	24.4	19.7	46.0	25.0	29.0
<i>Rhizophora. apiculata</i> Blume	36.8	29.1	32.2	58.7	17.3	23.1	46.0	25.0	29.0
<i>Bruguiera gymnorhiza</i> (L.)Lamk.	56.0	8.0	36.0	47.7	21.5	30.7	45.6	23.4	31.5
<i>Bruguiera cylindrica</i> (L.)Blume	-	-	-	-	-	-	-	-	-
<i>Bruguiera sexangula</i> (L.)Poir	57.0	32.0	13.3	61.5	37.5	0.98	59.6	34.2	15.7
<i>Bruguiera parviflora</i> W. & A.	-	-	-	-	-	-	55.1	35.3	26.7
<i>Kandelia candel</i> (L.) Druce	49.5	3.98	17.0	57.5	8.0	34.5	46.1	16.1	37.7
<i>Ceriops decandra</i> (Griff.)Ding. Hou.	54.7	27.7	17.5	43.3	34.8	19.8	48.5	32.5	18.9
<i>Ceriops tagal</i> (Perr.)Robin	52.3	25.6	18.6	63.5	30.5	10.9	46.8	30.2	16.7
<i>Avicennia alba</i> Blume	54.7	27.7	22.9	52.6	28.7	12.4	44.8	27.9	14.7
<i>Avicennia officinalis</i> L.	41.7	31.5	26.7	38.5	25.6	14.6	58.5	34.5	6.9
<i>Avicennia marina</i> (Forsk.)Vierh.	51.4	32.4	17.8	50.1	33.1	16.7	54.0	31.0	15.0
<i>Sonneratia apetala</i> Buch. Ham.	49.7	27.7	0.96	56.7	30.7	12.5	41.8	29.3	18.8
<i>Sonneratia caseolaris</i> (L.) Engler	-	-	-	-	-	-	-	-	-
<i>Sonneratia griffithii</i> Kurz.	35.	12.1	643.1	37.3	18.9	44.7	26.3	19.1	47.8
<i>Xylocarpus granatum</i> Koen.	43.1	21.4	31.2	40.1	27.1	32.7	45.9	30.9	23.0
<i>Xylocarpus mekongensis</i> Pierre	54.7	27.7	17.5	56.0	11.0	9.9	55.5	34.5	33.0
<i>Aegiceros corniculatum</i> (L.) Blanco.	41.1	24.1	34.7	54.0	8.25	37.7	45.8	31.3	22.8
<i>Aegialitis rotundifolia</i> Roxb.	49.5	33.5	17.0	58.7	36.7	12.1	51.3	34.5	17.3
<i>Heritiera fomes</i> Buch. Ham.	48.0	23.1	28.7	48.9	21.0	29.9	56.2	12.9	30.7
<i>Nypa fruticans</i> (Thunb.) Wurm.	46.8	27.3	25.8	59.9	30.8	14.2	58.7	35.6	23.4
<i>Phoenix paludosa</i> Roxb.	51.2	37.8	10.1	49.2	29.4	8.6	60.5	34.5	5.0
<i>Exoecaria. agallocha</i> L.	49.0	29.0	21.9	47.1	29.1	23.7	52.2	31.7	16.0

Table.3: Textural composition (%) of mangrove rhizosphere soils in western zone of Sundarbans Tiger Reserve.

Sp. Name	Western Zone								
	Matla			Netidhopani			Chottohardi		
	Sand	Silt	Clay	Sand	Silt	Clay	Sand	Silt	Clay
<i>Rhizophora mucronata</i> Lamk	46.1	21.7	32.1	43.2	19.3	29.7	48.9	23.4	38.7
<i>Rhizophora. apiculata</i> Blume	42.4	19.7	28.0	39.7	18.1	26.4	45.6	19.5	35.7
<i>Bruguiera gynmorrhiza</i> (L.)Lamk.	45.6	25.6	31.4	41.1	22.1	26.7	47.7	24.1	28.1
<i>Bruguiera cylindrica</i> (L.)Blume	52.3	34.5	11.6	-	-	-	54.5	35.4	10.8
<i>Bruguiera sexangula</i> (L.)Poir	-	-	-	-	-	-	61.2	39.8	30.2
<i>Bruguiera parviflora</i> W. & A.	58.7	37.8	21.2	60.6	23.1	16.1	48.2	35.2	23.5
<i>Kandelia candel</i> (L.) Druce	47.8	24.5	31.6	-	-	-	51.2	26.8	37.4
<i>Ceriops decandra</i> (Griff.)Ding. Hou.	49.3	35.7	25.4	51.2	47.8	22.5	40.4	33.4	26.1
<i>Ceriops tagal</i> (Perr.)Robin	42.1	31.6	26.1	44.3	29.7	23.1	49.5	29.2	21.1
<i>Avicennia alba</i> Blume	55.1	28.0	13.4	50.2	29.0	14.1	40.3	35.8	23.8
<i>Avicennia officinalis</i> L.	43.0	25.2	30.0	35.5	25.1	24.3	48.5	34.0	26.9
<i>Avicennia marina</i> (Forsk.)Vierh.	46.5	30.2	23.2	51.2	47.8	22.5	48.2	28.2	23.5
<i>Sonneratia apetala</i> Buch. Ham.	53.0	42.9	24.3	51.2	47.8	22.5	42.6	33.2	24.2
<i>Sonneratia caseolaris</i> (L.) Engler	-	-	-	-	-	-	-	-	-
<i>Sonneratia griffithii</i> Kurz.	35.6	29.1	39.1	31.2	26.1	38.2	37.2	23.2	39.6
<i>Xylocarpus granatum</i> Koen.	41.3	35.6	25.2	45.9	31.5	22.9	42.3	31.1	26.0
<i>Xylocarpus mekongensis</i> Pierre	41.3	35.6	25.2	46.5	31.2	27.1	42.6	33.2	24.2
<i>Aegiceros corniculatum</i> (L.) Blanco.	40.2	23.1	33.7	51.2	47.8	22.5	39.2	25.2	35.6
<i>Aegialitis rotundifolia</i> Roxb.	55.0	31.0	14.0	51.1	30.0	13.7	56.2	29.8	15.3
<i>Heritiera fomes</i> Buch. Ham.	44.8	19.8	35.3	43.5	16.0	31.6	45.0	18.3	34.0
<i>Nypa fruticans</i> (Thunb.) Wurmb.	57.8	22.3	20.1	59.1	21.9	18.9	56.2	21.0	17.8
<i>Phoenix paludosa</i> Roxb.	49.5	32.9	17.3	48.1	32.1	18.1	39.0	25.0	13.3
<i>Exoecaria. agallocha</i> L.	45.0	28.0	24.3	45.5	28.0	26.3	40.2	29.2	29.5

Table.4: Textural composition (%) of mangrove rhizosphere soils in central zone of Sundarbans Tiger Reserve.

Sp. Name	Central Zone								
	Chamta			Chandkhali			Goasaba		
	Sand	Silt	Clay	Sand	Silt	Clay	Sand	Silt	Clay
<i>Rhizophora mucronata</i> Lamk	49.6	22.2	30.6	42.1	20.1	26.3	47.1	23.7	29.1
<i>Rhizophora. apiculata</i> Blume	29.3	23.5	27.3	31.1	25.4	29.7	33.8	27.8	31.4
<i>Bruguiera gynmorrhiza</i> (L.)Lamk.	48.5	21.5	29.8	59.1	5.7	35.1	61.2	15.4	39.8
<i>Bruguiera cylindrica</i> (L.)Blume	56.7	35.7	9.8	63.4	39.7	11.8	61.0	33.0	6.0
<i>Bruguiera sexangula</i> (L.)Poir	46.5	27.5	25.9	-	-	-	59.7	34.5	25.6
<i>Bruguiera parviflora</i> W. & A.	53.2	30.2	16.5	58.7	33.7	7.5	62.1	36.9	23.4
<i>Kandelia candel</i> (L.) Druce	54.1	28.7	34.1	59.5	33.5	36.5	56.3	28.3	37.6
<i>Ceriops decandra</i> (Griff.)Ding. Hou.	49.1	33.1	17.9	54.1	32.1	15.9	50.2	36.7	29.8
<i>Ceriops tagal</i> (Perr.)Robin	60.5	34.5	4.9	49.5	30.5	7.5	58.0	30.0	4.0
<i>Avicennia alba</i> Blume	56.5	29.5	13.9	59.0	36.7	15.7	61.0	33.0	6.0
<i>Avicennia officinalis</i> L.	53.2	30.2	16.5	55.8	32.1	17.8	61.0	33.0	6.0
<i>Avicennia marina</i> (Forsk.)Vierh.	30.2	23.2	46.5	43.8	35.2	24.1	45.0	31.0	24.0
<i>Sonneratia apetala</i> Buch. Ham.	53.0	42.9	24.3	50.7	46.9	23.6	42.0	33.7	26.1

<i>Sonneratia caseolaris</i> (L.) Engler	-	-	-	-	-	-	-	-	-
<i>Sonneratia griffithii</i> Kurz.	32.2	13.0	55.0	33.1	16.0	58.7	61.0	33.0	6.0
<i>Xylocarpus granatum</i> Koen.	55.9	31.2	12.9	52.3	31.5	16.0	58.9	34.5	12.0
<i>Xylocarpus mekongensis</i> Pierre	47.5	31.2	17.4	58.7	33.7	7.5	62.3	19.6	14.8
<i>Aegiceros corniculatum</i> (L.) Blanco.	47.5	31.2	17.4	41.6	25.6	32.7	44.5	21.1	35.9
<i>Aegialitis rotundifolia</i> Roxb.	55.0	31.0	14.0	57.6	32.0	15.1	59.1	34.2	15.6
<i>Heritiera fomes</i> Buch. Ham.	44.8	19.8	35.3	44.0	20.1	27.8	43.5	26.0	31.6
<i>Nypa fruticans</i> (Thunb.) Wurm.	53.1	39.7	5.6	59.5	36.5	3.98	61.1	40.2	10.5
<i>Phoenix paludosa</i> Roxb.	39.5	32.9	17.5	40.1	28.8	13.4	44.5	28.9	13.0
<i>Exoecaria agallocha</i> L.	46.2	25.0	24.6	45.5	28.0	26.3	48.0	26.4	22.1

Table.5: Textural composition (%) of mangrove rhizosphere soils in northern zone of Sundarbans Tiger Reserve.

Sp. Name	Northern Zone								
	Jhilla			Pirkhali			Panchmukhani		
	Sand	Silt	Clay	Sand	Silt	Clay	Sand	Silt	Clay
<i>Rhizophora mucronata</i> Lamk	42.2	22.9	34.8	47.8	28.3	36.7	49.8	31.1	39.5
<i>Rhizophora. apiculata</i> Blume	46.0	20.7	36.7	42.2	22.9	34.8	46.2	29.1	37.7
<i>Bruguiera gynmorrhiza</i> (L.) Lamk.	44.3	16.3	28.7	42.1	10.1	25.4	47.6	13.4	29.8
<i>Bruguiera cylindrica</i> (L.) Blume	-	-	-	47.8	28.3	36.7	58.6	36.6	14.7
<i>Bruguiera sexangula</i> (L.) Poir	40.3	29.7	21.8	-	-	-	47.8	37.8	27.6
<i>Bruguiera parviflora</i> W. & A.	-	-	-	43.2	32.1	26.7	47.1	36.6	27.9
<i>Kandelia candel</i> (L.) Druce	-	-	-	45.2	21.3	32.1	49.4	23.6	33.4
<i>Ceriops decandra</i> (Griff.) Ding. Hou.	43.7	35.1	21.1	49.8	28.8	21.3	50.4	34.5	26.8
<i>Ceriops tagal</i> (Perr.) Robin	42.3	33.4	18.7	46.7	26.7	19.8	55.0	34.4	6.8
<i>Avicennia alba</i> Blume	44.5	33.2	14.2	47.8	28.3	36.7	48.5	35.1	15.1
<i>Avicennia officinalis</i> L.	-	-	-	-	-	-	-	-	-
<i>Avicennia marina</i> (Forsk.) Vierh.	47.4	35.6	13.1	48.5	35.2	15.2	48.0	35.0	17.0
<i>Sonneratia apetala</i> Buch. Ham.	45.2	25.7	12.1	46.7	30.2	13.6	41.2	28.3	18.8
<i>Sonneratia caseolaris</i> (L.) Engler	-	-	-	-	-	-	-	-	-
<i>Sonneratia griffithii</i> Kurz.	32.5	19.4	44.1	34.8	22.9	42.2	33.5	20.3	46.7
<i>Xylocarpus granatum</i> Koen.	42.5	19.7	31.6	41.1	26.5	31.9	48.1	30.1	21.7
<i>Xylocarpus mekongensis</i> Pierre	44.5	25.7	17.1	46.0	20.3	13.0	45.7	24.5	13.0
<i>Aegiceros corniculatum</i> (L.) Blanco.	44.5	21.8	37.5	47.8	28.3	36.7	45.0	25.6	36.8
<i>Aegialitis rotundifolia</i> Roxb.	39.8	34.1	23.4	47.8	28.3	36.7	40.5	35.6	24.7
<i>Heritiera fomes</i> Buch. Ham.	45.0	21.5	33.6	43.2	22.4	35.0	46.5	25.7	31.1
<i>Nypa fruticans</i> (Thunb.) Wurm.	51.1	36.5	13.5	50.5	33.2	14.7	49.4	32.1	14.0
<i>Phoenix paludosa</i> Roxb.	48.1	33.1	18.7	39.5	27.5	13.3	45.6	31.1	18.5
<i>Exoecaria agallocha</i> L.	45.1	29.1	25.7	41.2	29.4	26.7	46.1	27.8	25.8

Table.6: Textural composition (%) of mangrove rhizosphere soils in southern zone of Sundarbans Tiger Reserve.

Sp. Name	Southern Zone		
	Bagmara	Gona	Mayadwip

	Sand	Silt	Clay	Sand	Silt	Clay	Sand	Silt	Clay
Rhizophora mucronata Lamk	45.6	25.5	32.1	47.8	26.1	30.3	48.8	23.1	28.1
Rhizophora. apiculata Blume	46.7	26.6	34.5	51.1	28.9	37.1	49.7	26.9	36.2
Bruguiera gynmorhiza (L.)Lamk.	48.6	29.1	36.7	53.4	32.1	41.2	50.8	31.2	38.5
Bruguiera cylindrica (L.)Blume	-	-	-	-	-	-	49.1	32.1	10.3
Bruguiera sexangula (L.)Poir	-	-	-	-	-	-	-	-	-
Bruguiera parviflora W. & A.	44.3	36.7	25.4	46.7	37.9	29.4	38.2	31.7	17.3
Kandelia candel (L.) Druce	32.7	10.5	56.7	49.1	24.7	35.6	44.4	27.4	18.2
Ceriops decandra (Griff.)Ding. Hou.	45.6	34.5	27.6	49.7	35.6	28.1	43.3	36.2	25.5
Ceriops tagal (Perr.)Robin	44.1	31.2	20.6	46.7	34.5	23.5	45.1	33.4	21.4
Avicennia alba Blume	45.7	28.1	26.1	45.7	29.1	25.7	44.4	27.4	18.2
Avicennia officinalis L.	43.2	24.2	16.5	42.1	25.0	17.0	41.0	23.0	16.0
Avicennia marina (Forsk.)Vierh.	52.3	29.1	17.2	53.8	30.8	14.1	44.4	27.4	18.2
Sonneratia apetala Buch. Ham.	40.1	25.0	16.2	42.3	26.2	17.1	44.4	27.4	18.2
Sonneratia caseolaris (L.) Engler	23.7	36.5	39.7	-	-	-	-	-	-
Sonneratia griffithii Kurz.	30.7	13.6	55.7	31.1	12.0	56.1	34.5	20.0	55.3
Xylocarpus granatum Koen.	43.1	25.7	35.5	44.1	26.2	37.1	45.0	26.2	35.2
Xylocarpus mekongensis Pierre	41.5	33.0	25.1	40.4	38.7	24.3	42.6	33.2	24.2
Aegiceros corniculatum (L.) Blanco.	53.2	23.9	48.2	39.0	24.1	35.2	41.1	24.0	38.7
Aegialitis rotundifolia Roxb.	42.2	34.8	22.9	42.1	34.1	23.4	39.2	36.1	26.1
Heritiera fomes Buch. Ham.	44.0	22.6	35.7	44.2	22.3	35.0	53.6	24.5	30.5
Nypa fruticans (Thunb.) Wurm.	50.0	35.0	14.7	50.6	36.3	14.6	49.4	32.7	16.0
Phoenix paludosa Roxb.	49.6	35.3	17.4	42.3	37.1	19.7	45.6	33.1	18.1
Exoecaria. agallocha L.	44.6	29.0	26.5	43.6	27.7	26.1	45.0	27.1	25.4

Table.7: Relationship between the soil texture and the different species of mangroves in different zones of Sundarbans Tiger Reserve

Clay	Sandy Clay	Silty Clay	Clay Loam	Sandy Clay Loam	Loam	Sandy Loam
<i>S. griffithii</i>	<i>H. fomes</i> *	<i>S. caseolaris</i>	<i>R. mucronata</i> <i>R. apiculata</i> <i>X. granatum</i> <i>P. paludosa</i> <i>E. agallocha</i>	<i>B. gymnorrhiza</i> <i>K. candel</i> <i>A. officinalis</i> <i>S. apetala</i> <i>X. mekongensis</i> <i>A. corniculatum</i> <i>H. fomes</i>	<i>B. cylindrica</i> <i>C. decandra</i> <i>C. tagal</i> <i>A. alba</i> <i>A. marina</i> <i>X. mekongensis</i>	<i>B. sexangula</i> <i>B. parviflora</i> <i>A. rotundifolia</i> <i>N. fruticans</i>
			<i>B. gymnorrhiza</i> * <i>C. decandra</i> * <i>A. alba</i> *		<i>B. sexangula</i> * <i>B. parviflora</i> * <i>S. apetala</i> * <i>A. corniculatum</i> * <i>A. rotundifolia</i> * <i>N. fruticans</i> *	<i>B. cylindrica</i> * <i>C. tagal</i> * <i>A. alba</i> * <i>A. marina</i> * <i>X. granatum</i> * <i>X. mekongensis</i> * <i>P. paludosa</i> * <i>E. agallocha</i> *