Journal of Plantation Crops 11 (1): 24-32 June, 1983

A RATIONAL APPROACH TO THE MANAGEMENT OF COASTAL SANDS FOR ESTABLISHMENT AND PRODUCTION OF COCONUTS*

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ABSTRACT

The potential of different organic sources like coir dust, coconut sheddings, forest leaves and cattle manure blended with NPK straight fertilisers in establishment and growth of coconut seedlings were assessed at Central Plantation Crops Research Institute, Kasaragod. The data collected for a period of 10 years from 1971 revealed that the addition of blended organic sources, particularly forest leaves and cattle manure markedly enhanced the growth and vigour of coconut palms as compared to palms treated with NPK fertilisers alone (control). The application of these organic sources also efficiently reduced the average mortality of seedlings than those under control treatment. Even the flowering, an index of production, got enhanced in palms treated with blended organic matter. Considerable build up in organic carbon status of coastal sands after 10 years and improvement in related properties like water holding capacity and bulk density were noticed in plots receiving the blended organic treatments. The organic matter blending with NPK significantly increased the available soil N over control after sixth year.

INTRODUCTION

Managing the vast area of coastal sands for establishment of coconut plantations has always been a problem on account of poor water retention, low fertility status, etc. The present study was undertaken to gather information on the management of sandy soils by creating an organic matter rich profile around the feeding zone of coconut seedlings from the time of planting. Considering the advantages of blending organic and inorganic sources as a rational approach, the potentialities of agricultural and industrial waste materials like coir dust, coconut sheddings, forest leaves and cattle manure, were exploited.

MATERIALS AND METHODS

One year old West Coast Tall coconut seedlings were planted in one sq. m. pits at a distance of 8.0m×7.5m in the coastal sand (Quartzipsamments) in the beach block of the Central Plantation Crops Research Institute, Kasaragod. Mechanical analysis of the littoral sand tested, had 98 per cent sand, 0.2 per cent silt and 0.7 per cent clay. The planting was done in the year 1971.

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Five treatments *viz.*, NPK straight fertilisers alone, coir dust, coconut sheddings, forest leaves and cattle manure as organic treatments, were included in the experiment. The organic doses were supplemented with NPK straight fertilisers on an equivalent basis to supply 0.5 kg N, 0.32 kg P_2O_5 and 1.2 kg K_2O per palm per year. The fertilisers were applied according to the recommended practice (Nelliat, 1972) taking into consideration the age, season etc. The treatments were replicated five times with a net plot size of eight palms per plot. During the first two years, 10 kg of organic sources followed by inorganic sources were applied in June–July which were increased to 20 kg subsequently. The interval between the two applications was approximately 60 days each year.

Vegetative characters like the height of the palm, the number of leaves produced and the girth at collar were recorded in addition to flowering at the later stage.

Soil samples collected each year were analysed for organic carbon (Walkley and Black's method as described by Jackson, 1967), available nitrogen (Subbiah and Asija, 1956), phosphorus and potassium (Jackson, 1967). The water holding capacity and bulk density of the pre-treatment samples and samples collected during 1980 were also determined (Piper, 1966). Leaf samples were collected from the third year onwards following the diagnostic criteria proposed by Chapman (1964) and analysed for N, P, K, Fe, Mn, and Zn contents (Jackson, 1967). Atomic absorption spectrometer (Model–Varian Techtron AA 6) was employed for the determination of micro elements.

RESULTS AND DISCUSSION

The influence of organic sources on the growth parameters of the palms is presented in Fig. 1. In all the treatments where organic sources were blended with inorganics, the height and the number of leaves produced were more than in control. The beneficial influence of the treatments on growth parameters was statistically significant from 1974 onwards in comparison with control. During the period under observation, palms in plots receiving forest leaves had highest growth increments which were significantly different from control but were on par with palms receiving cattle manure. Considering the average leaf production during 1973–'75, 1976–'80 and 1973–'80, an increasing trend was revealed in organic treatments as compared to control. It was observed that after 10 years of planting such differences which were earlier observed due to treatment effects evened out. Similar were the findings for girth at collar (Manciot, Ollagnier and Ochs, 1979). There was an increase in growth and leaf production in the control palms during the later phase of vegetative growth, and by then the initiation in flowering was observed in palms treated with organics. It appears to be logical that in the former case the nutrient absorption is being utilized in vegetative production whereas in the latter, the same is being profitably diverted to reproductive phase and hence possibly a slight check in the rate of vegetative growth.

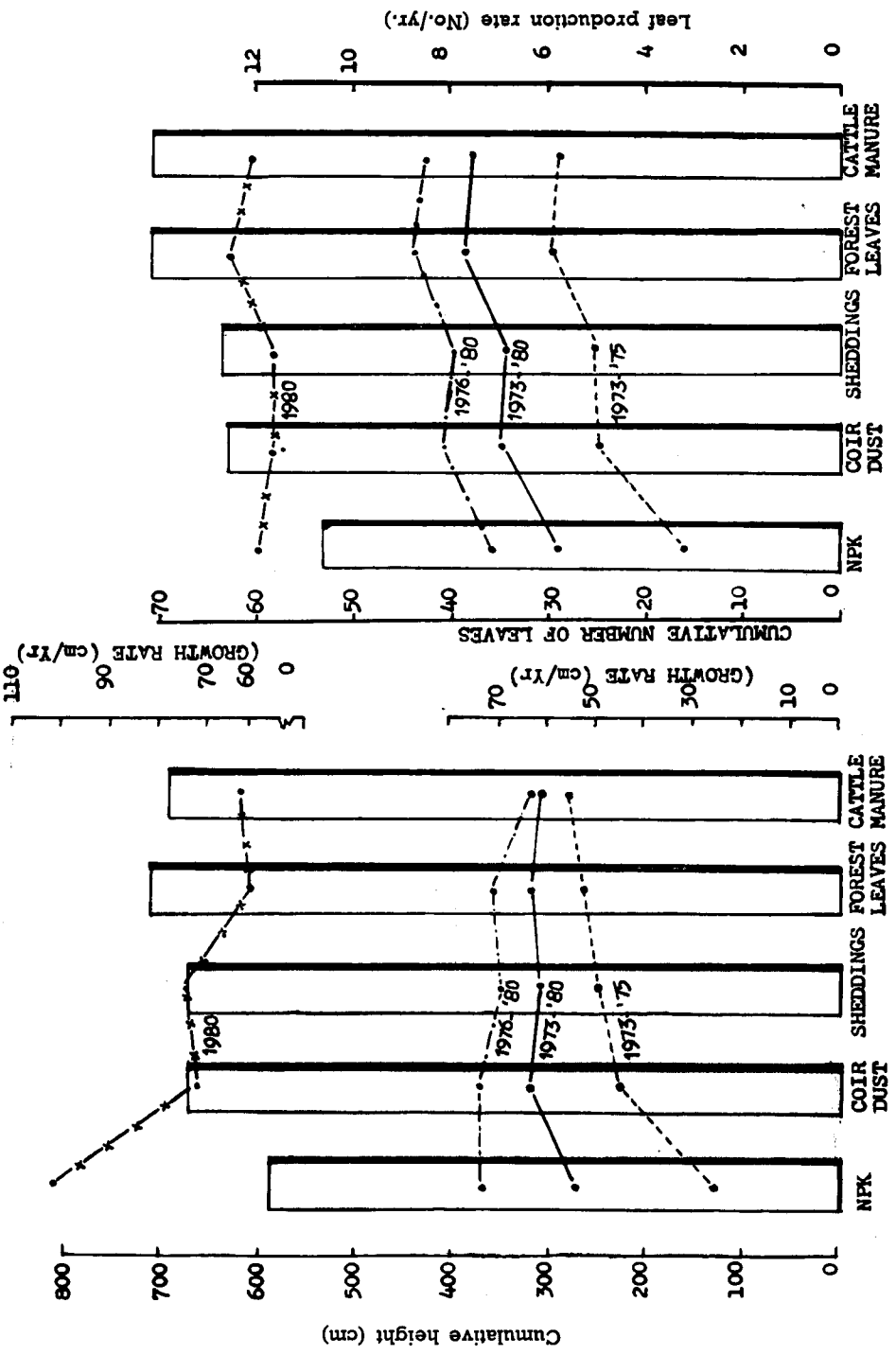


FIG. 1. INFLUENCE OF ORGANIC SOURCES ON PALM HEIGHT AND LEAF PRODUCTION

In several fruit trees including coconut palm, a high carbohydrate reserve has been reported as a pre-requisite for commencement of flowering (Ogaki and Fuzita, 1963; Ramadasan and Mathew, 1977). From Table I, it could be observed that the organic blended treatments helped in early and enhanced flowering. It is likely that the blended organic sources would have helped in building up improved carbohydrate and nitrogen reserves in these palms. In addition, the effect of organic matter, rich environment around the coconut seedlings was observed to lower the mortality (7 - 15%) compared to a mortality of as high as 50 per cent in control. This emphasises the need for the use of organics in managing littoral sands.

The initial soil pH of 6.5 had dropped to an average value of 4.6 irrespective of treatment effect when ammonium sulphate was used. No deleterious effects were observed on the palms. However, from 1977 onwards, urea was applied and a gradual upward trend of pH (around 5.5) was observed. The effect of organic sources could be noticed to influence the organic carbon levels only after about four years. Coir dust was superior in building up the soil organic matter status of the littoral sand followed by cattle manure, forest leaves and coconut sheddings. The contribution of applied organic matter in building the organic reserve of sub-soil is more or less uniform for all the sources except coconut sheddings which recorded lower values (Fig. 2). The initial water holding capacity was significantly increased from an average value of 20.4 per cent to 25.8 per cent, 26.0 per cent, 26.2 per cent and 27.5 per cent in plots treated with coconut sheddings forest leaves, cattle manure and coir dust, respectively. Eventhough the soil organic matter status of the top soil was more than the sub-soil (50 - 100 cm), the influence of higher contents did not appear to have contributed much in increasing the water holding capacity as the values for this parameter for 0-50 cm and 50-100 cm depths failed to show appreciable differences (Fig. 2). The bulk density values of surface soil showed a decreasing trend with the increasing values of organic carbon.

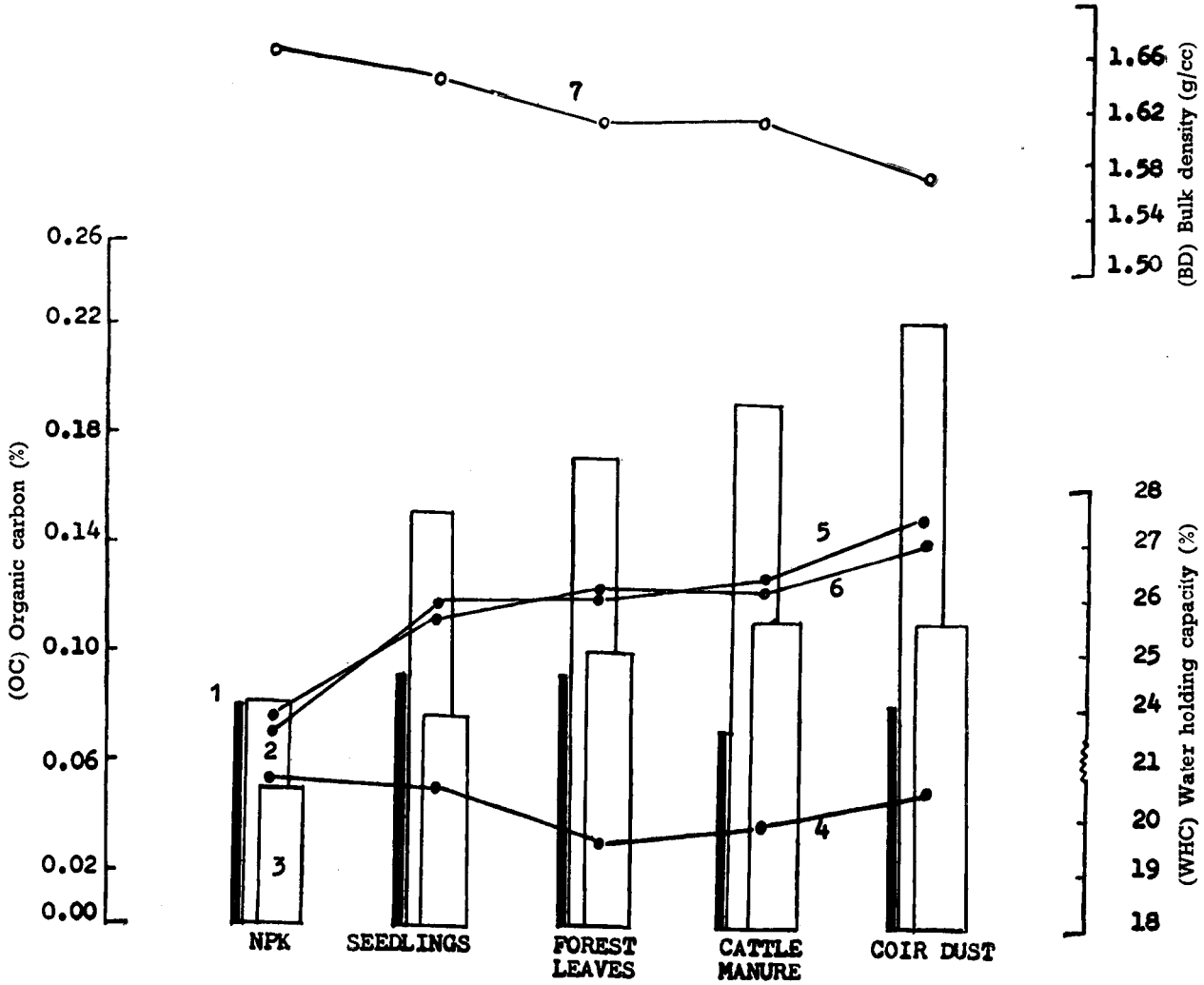
The influence of different treatments on available nutrients (contents of major

Table I. *Flowering behaviour under different treatments*

Year	NPK alone	Coir dust +NPK	Coconut sheddings +NPK	Forest leaves +NPK	Cattle manure +NPK
1977	NF	F	F	F	F
1978	NF	F	F	F	F
1979	NF	F	F	F	F
1980	F	F	F	F	F
Flowering percentage as on 1980	16.7	53.0	40.0	75.9	70.0

NF = Not flowered F = Flowered

FIG. 2. ORGANIC CARBON, WATER HOLDING CAPACITY AND BULK DENSITY AS INFLUENCED BY INORGANIC AND BLENDED ORGANIC SOURCES



nutrients) are presented in Table II. The available nitrogen status of the soil was not influenced until five years of treatments inspite of the increase and differences noted in treatments receiving organic matter contents. Only from sixth

Table II. *Effect of **inorganic** and blended organic sources on available nutrients (0–50 cm depth)*

	YEAR							
	1971*	1972	1974	1976	1977	1978	1979	1980
AVAILABLE NITROGEN (ppm)								
NPK alone	38.0	41.0	32.0	22.0	23.0	21.0	31.0	36.0
Coir dust	42.0	58.0	41.0	40.0	28.0	29.0	41.0	55.0
Coconut sheddings	39.0	49.0	51.0	40.0	28.0	29.0	41.0	57.0
Forest leaves	46.0	57.0	47.0	39.0	27.0	32.0	37.0	63.0
Cattle manure	41.0	55.0	40.0	42.0	29.0	37.0	44.0	66.0
C.D. @ 5%		NS	NS	4.6	NS	4.7	NS	11.4
AVAILABLE PHOSPHORUS (P) (ppm)								
NPK alone	19.1	21.2	60.8	65.3	87.3	69.5	71.1	105.8
Coir dust	19.5	10.1	81.2	86.5	88.7	75.8	66.9	124.2
Coconut sheddings	21.5	8.9	88.3	81.8	83.4	66.7	65.2	88.5
Forest leaves	19.0	11.0	64.1	94.1	81.3	58.4	64.6	81.1
Cattle manure	17.8	18.7	73.0	90.3	90.0	73.9	70.7	106.4
C.D. @ 5%		5.5	NS	9.5	NS	NS	NS	NS
AVAILABLE POTASH (K) (ppm)								
NPK alone	7.6	9.1	32.5	11.6	37.4	26.4	31.2	44.0
Coir dust	6.3	12.2	66.0	30.8	60.8	30.8	29.8	108.0
Coconut sheddings	8.2	10.8	51.3	39.6	65.0	30.6	38.0	73.0
Forest leaves	5.7	10.0	42.0	32.4	44.4	22.6	33.4	44.0
Cattle manure	9.0	13.0	44.5	52.0	55.8	27.6	35.6	95.2
C.D. @ 5%		NS	16.7	6.2	NS	4.0	NS	NS

* Pre-treatment data

NS—Not significant

year onwards the significant differences were observed. No significant difference due to the addition of phosphorus through inorganics and blended organics could be noticed eventhough a considerable build up of soil available P was noticed at 10th year. The sudden rise in available phosphorus after two years could be accounted for the amount of fertiliser applied; 1/3 and 2/3 during first and second year respectively and the full dose from third year onwards. Thereafter the level of available phosphorus was more or less maintained. The available potassium content also increased after 10 years but no significant differences were noticed. The available P and available K for organic blended treatments differed significantly over control in certain years.

The leaf nutrient levels of the diagnostic leaf of seedlings under different treatments (Table III) revealed that the differences in the foliar levels of N, P and K were not consistent due to treatment effects, though, an increase in leaf N was observed in later years. In the treated plots, due to high biomass production, the foliar potassium levels were found to reduce in the later years of growth whereas the control palms showed more or less the same K level. Significant differences due to Mn and Fe only (except for coconut sheddings) were observed between treated and control plots after five years (1976) eventhough the organics applied were good sources of other micronutrients (Table IV). However, such differences were not observed during later years. In spite of the fact that the major and micronutrient concentrations are not proportionately reflected in the foliar levels, their balanced and steady supply may be responsible for better performance of organics treated seedlings. Villemain (1965) was also of the opinion that nutrient balance of the palm could be improved by organic manuring.

Since all the palms were fertilised either with inorganic or blended organic sources, it was not possible to monitor through foliar levels as to which source of the nutrients are more responsible for the vigour of the seedlings. But through soil analysis a significant difference in available nitrogen was recorded from seventh year onwards in the basins of the treated palms. Early vigorous growth, precocity in flowering, less mortality etc. could be achieved only in organic treated palms. It is possible that continuous addition of organic matter might have resulted in partial humification and favourable effects of humic substances on growth and yield of crops as also have been reported by Flaig (1963). The physiologically active compounds generated during the humification might have helped in cutting down mortality in blended organics treatments. Such effects have been stated by Sochtig (1964). The importance of early vigour and fertilization in the performance of coconut palms has been well documented.

Hence it can be presumed that supplementation of organic sources with inorganic fertilisers (blending) is beneficial to coconut during establishment period in the coastal sandy soils than at later stages. It is possible that the enhanced buffering capacity of these littoral sands through the influence of organics in the slow and steady supply

Table III. *Effect of inorganic and blended organic sources on foliar nutrient status*

Year	TREATMENTS																	
	NPK alone	Coir dust	Sheddings	Forest leaves	Cattle manure	CD 5 %	NPK alone	Coir dust	Sheddings	Forest leaves	Cattle manure	CD 5 %	NPK alone	Coir dust	Sheddings	Forest leaves	Cattle manure	CD 5 %
	(N%)						(P%)						(K%)					
1974	1.76	1.76	1.64	1.61	1.67	NS	0.078	0.083	0.078	0.080	0.081	NS	1.85	2.09	2.10	2.13	2.20	0.16
1975	1.55	1.64	1.66	1.50	1.58	0.08	0.106	0.105	0.108	0.112	0.104	NS	1.69	1.88	0.86	1.83	1.86	NS
1976	1.41	1.63	1.66	1.60	1.64	0.11	0.103	0.106	0.114	0.120	0.114	0.011	1.71	1.52	1.54	1.41	1.54	NS
1977	1.79	1.83	1.84	1.80	1.65	NS	0.077	0.087	0.087	0.090	0.108	–	1.42	1.72	1.74	1.59	1.79	NS
1978	1.79	1.92	1.99	1.79	1.89	NS	0.099	0.120	0.124	0.114	0.118	0.011	1.64	1.58	1.50	1.48	1.48	–
1979	1.47	1.87	1.88	1.88	1.78	NS	0.074	0.101	0.096	0.096	0.090	NS	1.34	1.59	1.53	1.35	1.57	NS
1980	1.97	1.91	1.92	1.91	1.91	NS	0.099	0.084	0.068	0.095	0.102	NS	1.79	1.76	1.68	1.56	1.64	0.16
	Fe (ppm)						Mn (ppm)						Zn (ppm)					
1975	154	186	190	158	172		169	231	185	184	252		32	28	29	32	30	
1976	179	204	171	234	284		176	255	313	314	447		12	19	16	19	20	
1980	234	203	200	247	246		297	301	347	292	376		19	19	20	22	23	

Table IV. *Analysis of organic manures (oven dry basis)*

	N	P	K	Ca	Mg	S	Fe	Mn	Zn	B
	%					ppm				
Coir dust	0.5	0.08	0.50	0.23	0.58	3981	6013	67	83.0	14.8
Coconut shedding	0.6	0.04	0.40	0.31	0.41	1296	860	233	98.6	10.4
Forest leaf	1.6	0.10	0.95	0.77	0.72	2222	1867	109	71.4	28.0
Cattle manure	2.0	0.43	0.50	0.55	0.64	2778	4533	249	114.2	9.4

of nutrients and moisture, and indirect effects of organic matter might have contributed to the enhanced vegetative and reproductive characters observed. Of the organic sources compared, forest leaves and cattle manure seem to be better though coir dust and coconut sheddings could also be profitabily utilized for successful establishment and better performance of coconuts in coastal sandy soils.

ACKNOWLEDGEMENTS

The authors are indebted to Dr. K. V. Ahamed Bavappa, Director, Central Plantation Crops Research Institute, Kasaragod, for his keen interest in this study and also to Dr. N. M. Nayar, former Director, for the facilities rendered. Help rendered in statistical analysis by Mr. Jacob Mathew is duly acknowledged.

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