

EFFECT OF LONG TERM COCONUT-GRASS SYSTEM ON CERTAIN NUTRIENTS IN THE SOIL

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ABSTRACT

Nutrient profile, balance and input-output of nutrients over three block periods in an existing coconut fodder system under high rainfall condition of Kasaragod have been computed. Coconut-grass system enriched over control plot in organic carbon, nitrogen, manganese and copper in the surface soil while the nutrients in lower profile was low. While these elements were of net gain in the system over control, potassium, calcium, phosphorus and magnesium were on net loss. Over a period of fourteen years, guinea grass legume mixture gained NPK over other grass treatments. The input-output balance for the control plot (without grass) was negative for all the nutrients studied except phosphorus and potassium.

INTRODUCTION

Under the coconut based cropping system, there has been increase in the biomass of intercrops in about three years (Bavappa *et al.* 1986). Besides enhancing the organic matter status of the soil, intercrops improve physico-chemical and biological properties of the system. Though certain information on nutrient cycling, biomass addition, nutrient balances are available under coconut and arecanut based high density multispecies cropping system (Bavappa *et al.* 1986), information on coconut based grass ecosystem is lacking. In this paper, distribution, addition and loss of nutrients in such a system over a period of fourteen years are presented.

MATERIALS AND METHODS

The study was undertaken in an on going experiment of mixed farming system at the Central plantation Crops Research Institute, Kasaragod. The coconut plantation was cultivated with fodder grasses from 1972. The grass species namely hybrid napier grass (Gajraj) and *Stylosanthes gracilis* were grown upto 1975. Later the treatments were modified with the following main crops viz. coconut-pepper, coconut-pepper-banana, subabul-pepper and clove, the interspace being planted with fodder varieties such as guinea grass-legume mixture, hybrid napier (NB 21), Guinea grass (Guatemala) and control. The total area covered under these crops was 1.04 ha. During dry months (December to May) sprinkler irrigation was

adopted in the field. N:P:K @ 150:50:100 kg/ha/yr was applied for the fodder as split dose.

Soil samples were collected in the month of May, 1987 for every 100 cms depth at the interspace of the coconut where fodder crop was grown. Soil samples were also collected for comparison from an adjacent plot with coconut as monocrop of similar age. Leaf samples from all the crop community from the system were collected as suggested by Chapman (1961). Organic carbon, soil pH, available N, P, K, Ca and Mg were determined by the standard methods. Zn, Mn, Cu and Fe were determined in the 0.01N D. T. P. A. extract (Lindsay and Norvell, 1968) with Varian A. A. S. 995 model. Similarly, leaf nutrient concentration was determined in di-acid (1:4 perchloric: nitric acid extract (Jackson, 1967).

RESULTS AND DISCUSSION

Soil nutrients

The data on the various nutrients at different depths are depicted in Fig. 1 to 3. The organic carbon content progressively decreased in the soil profile upto a depth of one meter (Fig. 1B). Guinea grass and NB 21 plots showed high organic matter content in the first 20 cm followed by guinea grass-legume (GL) mixture and control. Available nitrogen content was higher in the surface soil of NB 21 and guinea grass plots followed by control and guinea grass-legume mixture (Fig. 1A). Between 40-80 cm depth, there was a general reduction in this parameter.

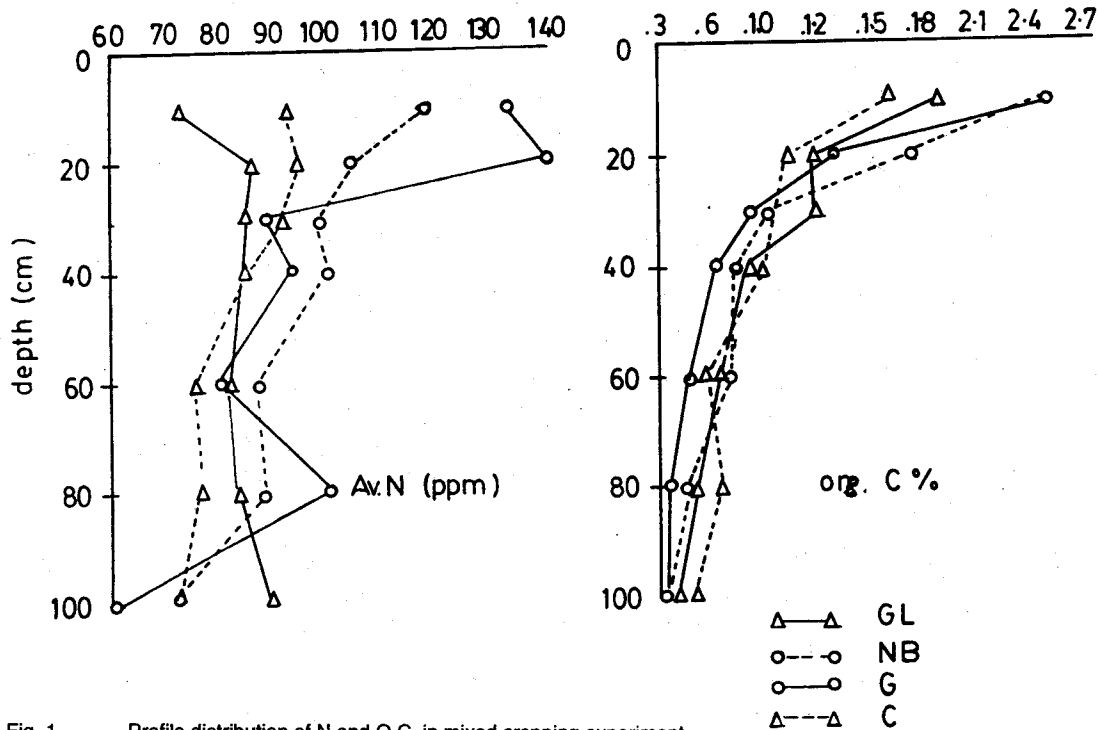


Fig. 1 Profile distribution of N and O.C. in mixed cropping experiment

The phosphorus content was low in control throughout the depth of the soil while guinea grass and NB 21 showed an accumulation at 20-30 cm depth (Fig. 2A). Guinea grass-legume mixture showed accumulation at 40-60 cm depth. The reduction of nutrient P was sharp below 60cm in all treatments except guinea grass legume. The K content in the soil profile was uniformly low with depth in the case of GL and NB 21. Fairly higher concentration of K (100 ppm) among all the treatments was recorded by guinea grass at all depths except in 20, 80 and 100 cm depth (Fig. 2B). The K content in the control plot was slightly higher than that of grass cultured plots at 80cm depth. The calcium and magnesium content sharply decreased upto a depth of 20-30 cm in all the treatments (Fig. 2C, D). Control plot showed slightly higher content of these elements than plots with grass. However, in the control plots the Ca and Mg concentration showed a steady level from 20-100 cm.

The iron and zinc contents showed sharp decrease in the surface soil upto 80 cm depth

beyond which the decrease was marginal. These nutrients were higher in control compared to the rest of the plots (Fig. 3A, C). In the case of Mn, the control plot had lower concentration than the cultured plots (Fig. 3B). The zone of the depletion appeared to be 20-40 cm. The copper content in control plot is far exceeding than those of grass cultured soils (Fig. 3B).

From the results it is clear that NB 21 grass influenced the surface soils to enrich organic carbon, nitrogen, magnesium, manganese and copper to a great extent over a period of fourteen years. Similarly guinea grass enhanced the level of nitrogen, organic carbon, potassium, calcium, magnesium, iron and manganese in the surface soil as compared to control. This is in agreement with the report of Patil (1980) who stated that there was relative build up of all the major nutrients and organic matter by proper grassland management. The lower depths showed lower nutrient concentration in this study. This is substantiated by the lower biomass in the lower depths as stated by

Vaughan and Malcohm (1985).

The data presented in the Table-1 depicts the net balance of soil nutrients and gain/loss of nutrient in different grass cultured treatments over control. The results showed that organic carbon, available nitrogen, available Mn and Zn have been gained by the soil cultured with grasses over control. The magnitude of gain varied with the nutrients and extent of their recycling. Maximum gain was recorded with organic carbon followed by available nitrogen. Among grass treatment, NB 21 for organic carbon, available N and Mn; grass-legume mixture for organic carbon, available nitrogen, Mn and Zn; and guinea grass for organic carbon, available N, Mn and Zn had profound influence. On

the other hand, the rest of the nutrients showed a negative gain over control. In other words, rapid exhaustion of these nutrients had taken place due to grass culture. Among the nutrients, K had shown maximum depletion followed by Ca, P and Mg. Among the grass treatment, guinea grass-legume mixture influenced most on available P, available Mg, available Fe, and available Cu, while guinea grass alone markedly decreased the available K whereas NB 21 decreased the available Ca most.

Nutrient Balance

The results summarised in Table II indicate the nutrient input and output balance for a block of every five years since 1972 to 1986 by taking into consideration various possible

Table I. Gain/Loss of nutrient in the soil under grass-coconut culture (kg/ha) (after 14 years)

Cropping	Organic - carbon quantity		Av. N quantity		Av. P quantity		Av. K quantity		Av. Ca quantity	
	G/L	G/L	G/L	G/L	G/L	G/L	G/L	G/L	G/L	
GL	12584	+283	1426	+174	207	-212	228	-688	599	-103
NB	14705	+2404	1356	+104	326	-93	444	-472	552	-150
G	13008	+707	1414	+162	258	-161	202	-714	623	-79
Coconut	12301	-	1252	-	419	-	916	-	702	-

Cropping	Av. Mg. quantity		Av. Fe quantity		Av. Mn quantity		Av. Cu quantity		Av. Zn quantity	
	G/L	G/L	G/L	G/L	G/L	G/L	G/L	G/L	G/L	
GL	89	-72	182	-129	438	+135	7.07	-8.48	16.4	+4.3
NB	127	-34	198	-113	451	+148	7.21	-8.34	13.0	+0.9
G	113	-48	194	-117	382	+79	8.77	-6.78	13.2	+1.1
Coconut	161	-	311	-	303	-	15.55	-	12.1	-

G/L : gain/loss

Table II. Net input - output balance of nutrients as a function of time in coconut - grass intercrops

Year	Intercrop	N kg/ha	P kg/ha	K kg/ha	Ca kg/ha	Mg kg/ha	Mn G/L	Fe G/L	Cu G/L	Zn G/L
1976	GL	66	48	186	-13	-16	170	2466	81	475
	NB	19	36	90	-16	-21	-425	2205	69	438
	G	44	33	71	-15	-19	-785	2272	72	439
	Coconut	-38	15	60	-22	-24	-75	-76	-18	-26
1981	GL	62	47	184	-13	-16	246	2591	84	504
	NB	24	40	94	-16	-19	-166	2484	74	480
	G	46	39	94	-16	-17	-460	2459	79	484
	Coconut	-34	15	59	-22	-24	-92	-80	-18	-31
1986	GL	81	58	189	-9	-14	355	3594	122	713
	NB	43	48	107	-10	-16	-106	3473	113	685
	G	66	47	100	-9	-14	-362	3457	118	692
	Coconut	-32	15	60	-22	-24	-94	-78	-18	-30

G/L : gain/loss

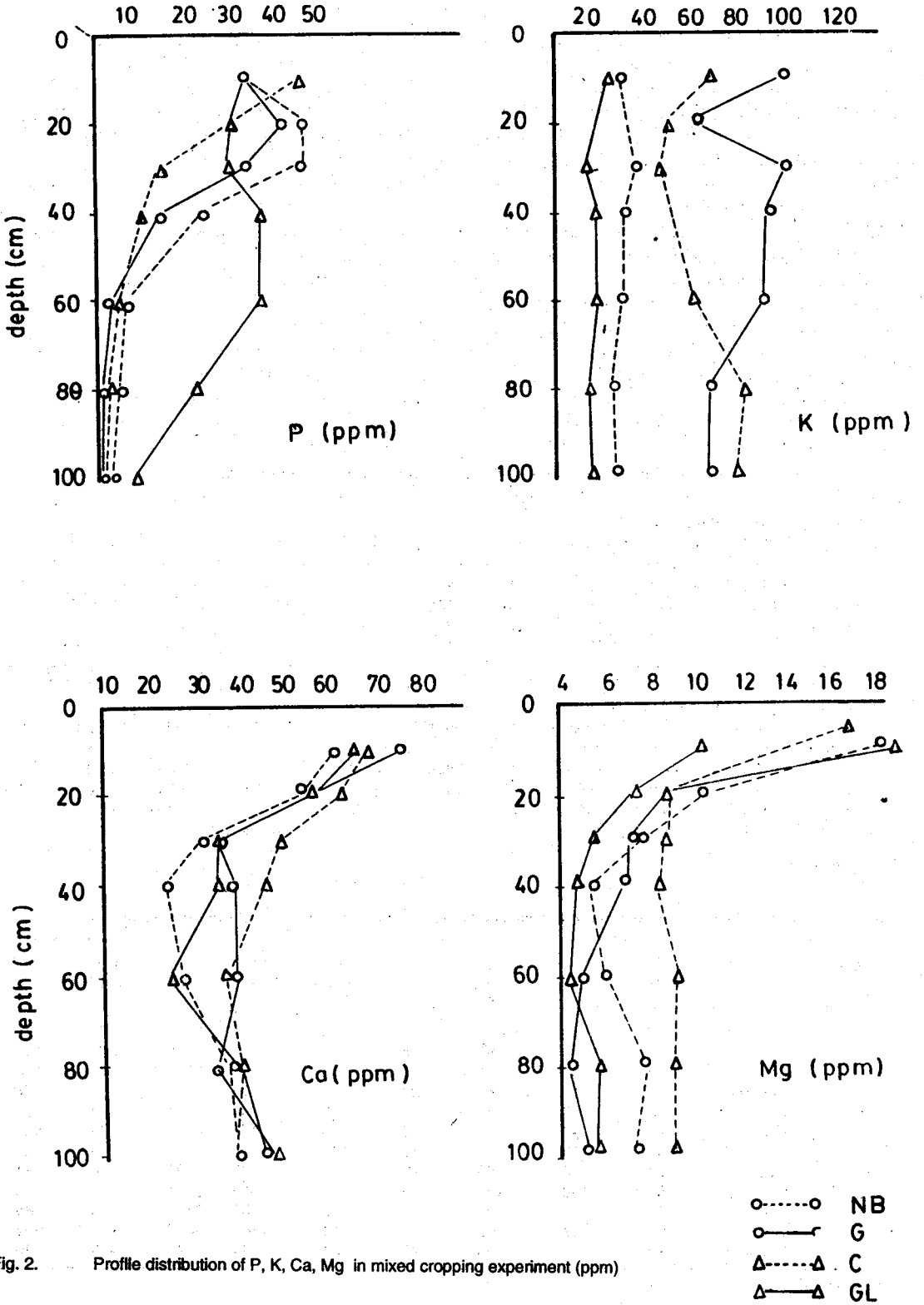


Fig. 2. Profile distribution of P, K, Ca, Mg in mixed cropping experiment (ppm)

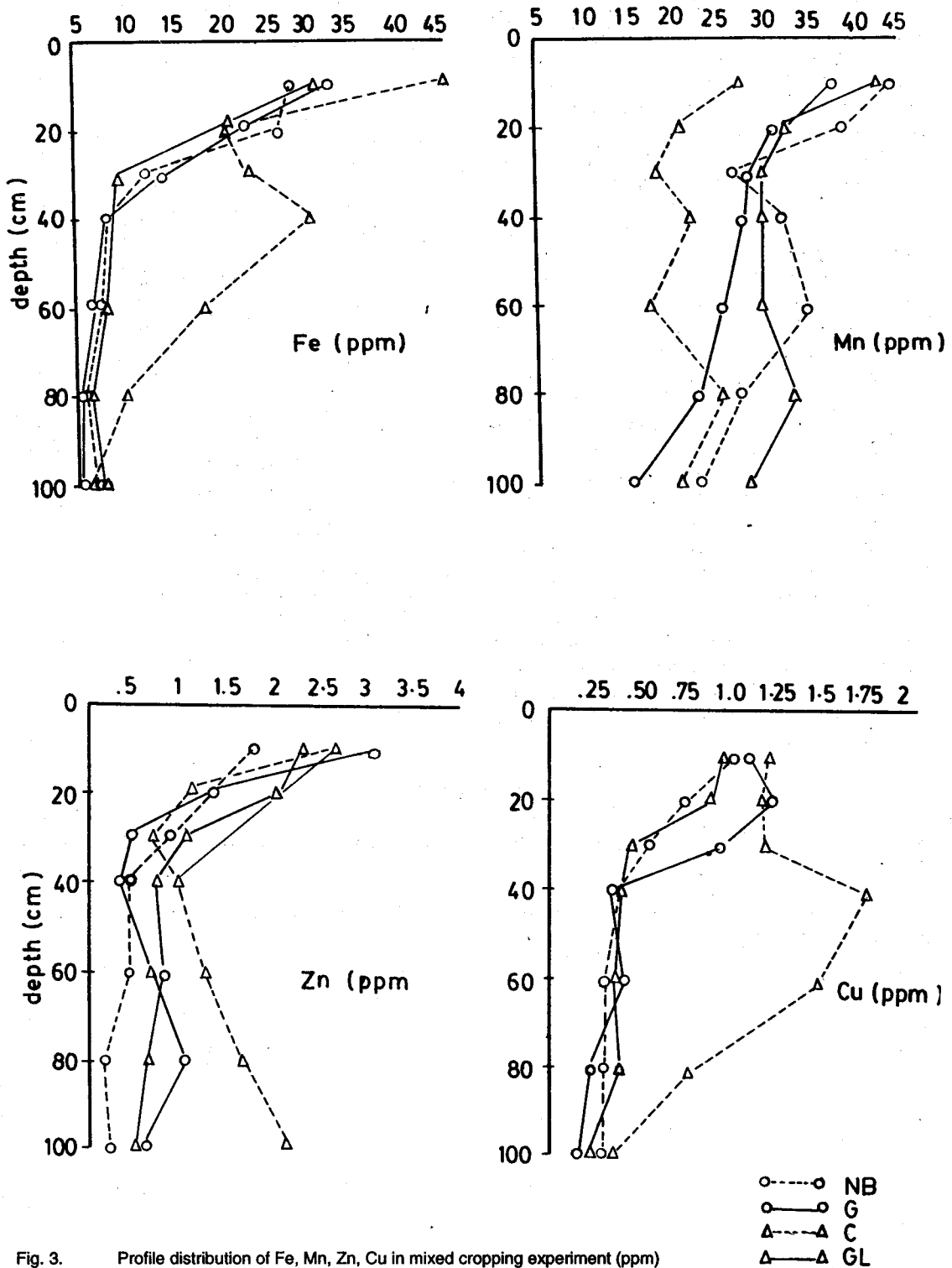


Fig. 3. Profile distribution of Fe, Mn, Zn, Cu in mixed cropping experiment (ppm)

sources of input and output of nutrients in the system. It is seen from the results that a net positive balance of nitrogen, phosphorus and potassium is an indication of progressive enrichment in the grass cultured system. However in the control plot, the nitrogen balance is negative for all the three block years indicating the output was more than the input. On the other hand the P and K had shown a net positive balance in the control (monocrop) plots. Among the grass cultures, guinea grass-legume mixture had favoured higher gain of NPK over the other grass treatment, whereas the balance of Ca, Mg, Mn, and Cu was negative irrespective of monocrop or mixed cropping with grass in all the block years. This is mainly due to the fact that these nutrients have not been added through fertilizer but only recycled within the system. The magnitude of negative balance was more for the monocrop plot compared to grass cultured plots. This shows that a part of these nutrients are recycled through residues, crop litter fall and the recycling of urine and dung from the dairy. The data pertaining to Fe and Zn revealed that there is a positive (input-output) balance. Although these nutrients have not been amended through fertilizers, the effective and efficient recycling process would have resulted in the positive balance. The input-output balance for the monocrop plot was always negative for all nutrients except for K in all the three block years.

DISCUSSION

K.V. PETER : What is the botanical name/cultivar of grass grown under coconut? Is it shade loving/tolerant?

M.G. BOPAIAH : The names of grasses are 'Hybrid Napier' *Pennisetum purpureum* (N.B. 21) and 'Guinea grass' *Panicum maximum* (Guatemala). They are not shade loving.

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