Research findings

I Site-specific nutrient management in coconut plantations

H.A.J. Gunathilake[(1)], H.M.S.K. Herath[(1)], and V. Nosov[(2)].

Introduction

Adequate fertilization of coconut palm is very important to increase the yield as well as the quality of coconut production in Sri Lanka. Most soils throughout the country are highly weathered and of low fertility. Soil fertility management is thus important and exceptionally so in coconut plantations as coconut is a perennial plant with a continuous productive life. However, mineral fertilizer use in the coconut sector of Sri Lanka is still low and stagnant (Table 1). Although 80-90 per cent of estates (>8 ha) are regularly fertilized, these estates represent only about 18 per cent of the total land area devoted to coconut production. The remaining 82 per cent, is occupied by smallholders (<8 ha) who apply considerably lower fertilizer rates as compared with the average levels indicated in Table 1.

Table 1. Area, yield and fertilizer consumption in the coconut sector of Sri Lanka.

Year	Area	Yield	Fertilizer application							
			N	P_2O_5	K_2O	MgO	N	P_2O_5	K_2O	MgO
	'000 ha	*nuts/ha*	---------- *'000 t* ----------				---------- *kg/ha* ----------			
2002	442.4	5,407	4.2	3.0	7.9	0.6	9.5	6.8	17.9	1.4
2003	442.4	5,791	4.1	3.1	8.8	0.5	9.3	7.0	19.9	1.1
2004	394.0	6,486	4.3	2.5	7.2	0.4	10.9	6.3	18.3	1.0
2005	394.8	6,370	4.3	2.3	6.7	0.5	10.9	5.8	17.0	1.3
2006	394.8	7,054	3.3	3.0	7.0	0.3	8.4	7.6	17.7	0.8

Sources: 1) Plantation Sector Statistical Pocket Book 2007, Ministry of Plantation Industries of Sri Lanka, 2007; *2)* The Review of Fertilizer Year 2006. National Fertilizer Secretariat of Sri Lanka, 2007.

An experimental site in a coconut plantation in Sri Lanka. Photo by IPI.

Research and extension activities play a significant role in achieving the national production target of 3,000 million nuts per year, an eight per cent increase over 2006 production levels. The launching of awareness programs and the initiation of field demonstrations among coconut growers at farmers level are the most effective strategies to optimize fertilizer use in coconut.

Materials and methods

In this IPI-CCB project, three demonstration experiments were conducted in 2006-2007 in the following locations (see map):

1. A wet zone (annual rainfall >2,500 mm): Milathe, Kiridiwala, Gampaha district;

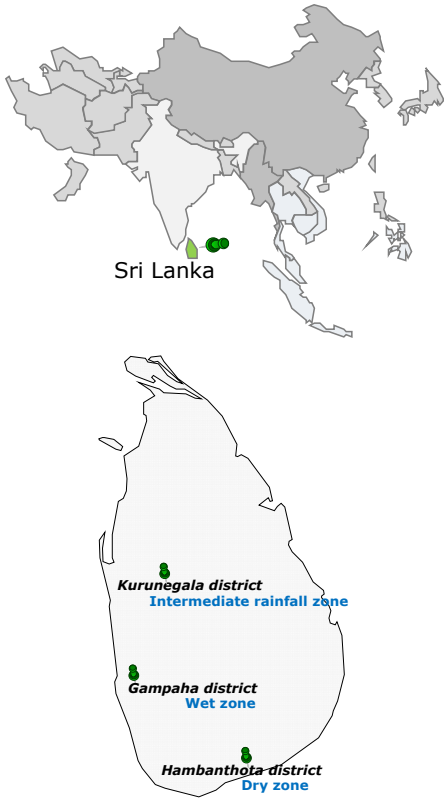
2. An intermediate rainfall zone (1,500-2,500 mm): Olagama, Ridigama, Kurunegala district;

3. A dry zone (<1,500 mm): Mulgirigala, Hambanthota district.

The selected coconut plantations had not been fertilized for a long period of time, thereby allowing the effect of fertilizer application to be revealed clearly after the start of fertilization. Visual nutrient deficiency symptoms, especially N- and K-deficiency symptoms, could be observed in palms in all three locations.

The plot size was about 0.25 ha for each treatment (with ~40 palms per plot). The experimental plots were separated by a guard row to maintain a buffer zone in between treatments. Two fertilizer treatments were applied in each location (Table 2). Fertilizers were applied manually as a single dose application. Other cultural practices were adopted as recommended by the Coconut Research Institute of Sri Lanka.

The total nut yield of each treatment was recorded during 2006 and 2007. The average nut yield per palm per year was then calculated.



Maps of the region and Sri Lanka with precipitation zones.

(1) *Coconut Cultivation Board (CCB), Sri Lanka*

(2) *International Potash Institute*

Research findings

Soil samples were taken one year after the first fertilizer application (just before the application of fertilizers during the second year).

Typical coconut plantation in Sri Lanka. Photo by IPI.

Table 2. Treatment description.

Treatment	Description	APM*	N	P_2O_5	K_2O	Dolomite
		kg/palm/yr				
1	50% recommended dose	1.5	0.18	0.09	0.48	0.5
2	100% recommended dose	3.0	0.37	0.18	0.96	1.0

* APM – Adult Palm Mixture (12-6-32): 3 kg APM consists of 0.8 kg of urea, 0.6 kg of rock phosphate (30% P_2O_5), and 1.6 kg of MOP.

Results and discussion

Soil physical and chemical properties

Soil texture varied between experimental sites from sandy loam to sandy clay loam (Table 3). Coconut performs well within these soil textural classes if other conditions are good. Soils at the Dry zone site were classified as alfisol whereas those at the other two locations were ultisols. Soils are acidic or slightly acidic, with a low salinity level. Available P (Olsen) is medium to high, available K ranges from low to medium (outside the manure cycle).

Yield response of coconut palm to mineral fertilizers

The majority of palms showing nutrient deficiency symptoms started to recover after three months following the first fertilizer application. Leaves turned from yellow to a more greenish color that was more obvious in treatment 2 (100% recommended dose of APM) as compared to treatment one (50% recommended dose of APM). Palms in the surrounding areas, where fertilizers were not applied, remained under nutrient deficient conditions. A considerable increase in nut yield was observed 3-4 months after the start of fertilizer application in all the locations.

1) Wet zone

The nut yield of coconut obtained during the year 2006 was 43.1 and 54.3 nuts/palm/year in treatments one and two, respectively (Fig. 1). Thus, nut yield increase in treatment two over the treatment one was 26 per cent.

In 2007, nut yield increased from 45.2 nuts/palm/year (treatment one) to 70.5 nuts/palm/year (treatment two). Hence, there was a yield increment of 56 per cent.

2) Intermediate zone

Coconut yield in treatments one and two during 2006 was 37.5 and 52.3 nuts/palm/year, respectively (Fig. 1). This gives a yield increase of 39 per cent in treatment two as compared to treatment one.

In 2007, the yield of nuts in treatments one and two was 51.5 and 73.4 nuts/palm/year, accordingly. Thus, there was 43 per cent nut yield increase.

Table 3. Some soil properties in experimental plantations.

Location	Treatment	Soil texture	pH_{H2O}	EC	Available P (Olsen)	Available K
				dS/m	*mg/kg soil*	*meq/100 g soil*
Wet zone (Gampaha district)	Control*	Sandy loam	5.32	0.17	16.7	0.09
	1		5.35	0.30	11.3	0.23
	2		5.56	0.38	14.6	0.34
Intermediate zone (Kurunegala district)	Control*	Sandy loam	5.91	0.22	23.4	0.12
	1		5.80	0.20	11.3	0.47
	2	Sandy clay loam	5.94	0.29	17.1	0.71
Dry zone (Hambanthota district)	Control*	Sandy clay loam	5.96	0.25	10.5	0.27
	1		6.21	0.89	13.0	1.07
	2		6.31	0.64	18.0	0.34

* Soil samples taken from outside the manure cycle.

Research findings

3) Dry zone

Nut yield in treatments one and two during 2006 was 39.2 and 51.9 nuts/palm/year, respectively (Fig. 1). The yield increase in treatment two over treatment one was 32 per cent.

In 2007, nut yield increased from 52.6 nuts/palm/year (treatment1) to 68.8 nuts/palm/year (treatment two). This gives a nut yield increment by 31 per cent.

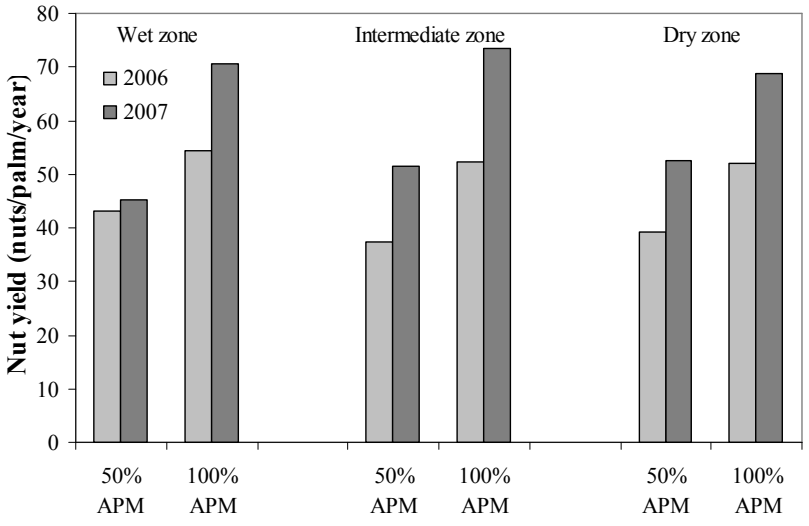


Fig 1. Coconut yields in the Wet, Intermediate and Dry zone sites, 2006 and 2007.

Conclusions

High fertilizer use efficiency was clearly observed in all the locations as experiments were conducted in the long-term non-fertilized coconut plantations with low soil fertility. Coconut palms strongly responded to the recommended dose of mineral fertilizers compared to the half-recommended rate. The highest average response to mineral fertilizers was observed in the Wet and Intermediate zones of Sri Lanka (41%) followed by the Dry zone (32%). Fertilizer response, in fact, is associated with favorable climate (sunshine hours and rainfall). In the Dry zone, the low rainfall (low soil moisture) is the most critical factor to restricting yield.

The recommended use of mineral fertilizers for coconut is much needed to increase coconut yield and to maintain soil fertility in Sri Lanka.

*****

Sri Lankan farmers gathering to discuss the results of the demonstration experiments. Photo by V. Nosov.

About coconut

Coconut is grown globally on more than 10 million ha, mostly in "Low Income Food Deficit Countries" (FAO). The main growing countries are the Philippines, Indonesia, India and Sri Lanka (3.5, 2.6, 1.9, and 0.4 million ha, respectively; data for 2007).

Productivity of coconut is improving, although globally the rate is only one per cent per year from 1990 to 2007.

Typical removal rate of nutrients is shown in the adjacent table.

Nutrient removal by coconut monoculture at yield level of 7,500 nuts/ha, or equivalent of 150 palm/ha.

Part	N	P	K	Mg
	----------	*kg/ha*	----------	
Inflorescence	7.9	1.9	16.3	3.2
Fronds	33.4	3.3	43.6	20.3
Nuts				
Nut water	0.3	0.1	3.3	0.1
Shell	1.8	0.1	3.1	0.2
Kernel	19.9	2.8	10.5	1.6
Husk	10.6	1.2	63.2	2.5
Total by nuts	*32.6*	*4.2*	*80.1*	*4.4*

Adapted from Gunathilake and Manjula, 2006. Balanced fertilization for sustainable coconut and coconut-intercrop systems in Sri Lanka. Pp 415-425. *In*: Balanced fertilization for sustaining crop productivity. D.K. Benbi, M.S. Brar and S.K. Bansal (eds.). IPI proceedings, ISBN 978-3-9523243-2-5.