

Coconut (*Cocos nucifera* L.)

French: Cocotier; Spanish: Cocotero; Italian: Cocco; German: Kokosnusspalme

Crop Data

Perennial. Harvested part: mature nuts (11 1/2-12 month-old), tender nuts (7-8 month-old).

Planted any time of the year, but preferably at start of rainy season.

Flowers: tall varieties 4 1/2-5 years from field-planting; dwarf varieties 2-3 years from field-planting; dwarf x tall hybrids 3-4 years from field-planting.

Differentiation of flower primordia: 22 months before flowering.

Nut maturity: 12 months after complete pollen fertilization of female flowers (buttons); 1 nut bunch matures each month; 10-14 bunches per palm at different maturity stages at any one time.

Planting density: 100-200 trees/ha on square system or 115-236 trees/ha on tri-angular system with 7 to 10 m spacing (dwarf varieties are planted at 7-8 m, hybrids at 8-8.5 m and tall varieties at 9-10 m spacing).

Preferably grown on deep, well-drained, light to medium textured soils, pH 6-7, rich in organic matter, high in fertility level (including soil chloride).

The crop is grown commercially between latitudes 20 °N and 20 °S; at altitudes of 600 m or less; with temperature range 24-29 °C, relative humidity 80-90 %, rainfall 1 500-2 300 mm evenly distributed throughout the year.

Generally, the crop is not irrigated except for seed production (seed gardens).

Average annual yields of 80-150 nuts per tree (2-4 t/ha of copra) are attained under favorable growing conditions, depending on the variety or hybrid type.

Nutrient demand/uptake/removal

One hectare of coconuts (average of 150 palms) producing 12-14 leaves and 100 nuts/tree/year contains in the harvest (matured bunches) the following amount of nutrients (per year): 49 kg N, 16 kg P₂O₅, 115 kg K₂O, 5 kg Ca, 8 kg Mg, 11 kg Na, 64 kg Cl and 4 kg S. The husk contains 60 % of the K₂O, 18 % of N and 26 % of Mg removed in the harvest. It is therefore recommended that wastes such as coconut husks and leaf fronds be left in the field to undergo decomposition and mineralisation so that nutrients eventually return to the crop.

Nutrient demand/uptake/removal - Macronutrients									
Yield	Source	kg/ha							
		N	P2O5	K2O	Mg	Ca	S	Na	Cl
1.5 t copra	Copeland, 1931	93	41	138	-	17	-	-	-
25 nuts/palm	Cooke, 1950	29	9	26	-	-	-	-	-
60 nuts/palm	Nathaniel, 1969	72	39	108	-	-	-	-	-
100 nuts/palm: nuts only whole palm	Khanna and Nair, 1977	120	18	85	-	-	-	-	-
		157	28	346	-	-	-	-	-
100 nuts/palm	Ouvier and Ochs, 1978	49	16	115	8	5	4	11	64
6.7t copra: nuts only whole palm	Ouvier and Ochs, 1978	108	39	232	15	9	9	20	125
		174	46	299	39	70	30	54	249
1 t copra	Ashgar, 1988	16.2	5	36	2	1.4	1.3	2.5	19.7

Plant analysis data

In foliar diagnosis, a composite sample of palms grown under similar conditions is collected at intervals. For a particular stage or age of coconuts, leaf sampling is done on the selected leaf rank (number) of the palm based on its phyllotaxy. Depending on the average count of living or functional leaves at sampling time, a guide to the proper leaf rank to be sampled was recommended by Magat and Prudente (1979) as follows:

Living leaves average count (5-10 leaves)	Stage	Leaf rank to sample
4-6	Nursery	1
7-12	Nursery/field	3 or 4
13-18	Pre-bearing	9
19 or more	Bearing	14

Critical levels for the 14th leaf at the bearing stage - Macronutrients									
Variety	Source	% of dry matter							
		N	P	K	Mg	Ca	Na	Cl	S
Local tall varieties	Fremond (1966)	1.8-2.0	0.12	0.8-1.0	0.20	0.50	0.4	0.5	0.15-
	Kanapathy (1971)	1.8	0.12	0.8-1.1	0.30	0.30	-	-	-
	Friend (1975)	2.0	0.14	1.0	0.26	0.55	0.2	-	-
	Magat (1979)	1.8	0.12	0.8	0.20	0.30	0.1	0.3-0.4	0.13
		2.0 (OL)*	0.14 (OL)	1.0 (OL)	0.30 (OL)	0.50 (OL)	0.2 (OL)	0.5-0.6 (OL)	0.17 (OL)
	CRISL** (1988)	1.8-2.1	0.11-0.12	1.2-1.4	0.25-0.35	0.35-0.50	0.4	0.3-0.6	0.15-0.20
Dwarf varieties	Chew (1982)	1.8-2.0	0.12	0.6-0.8	0.25	0.15-0.20	-	-	-
Hybrids	Manciot et al (1979)	2.2	0.12	1.4	0.20	-	-	-	-
	Magat (1988)	1.8	0.12	0.9	0.30	0.32	0.15	0.45	0.15
		2.0 (OL)*	0.13 (OL)	1.1 (OL)	0.33 (OL)	0.35 (OL)	0.17 (OL)	0.50 (OL)	0.16 (OL)

* Optimum Level ** Coconut Research Institute of Sri Lanka

Coconut - Critical levels for the 14th leaf at the bearing stag - Micronutrients						
Variety	Source	ppm dry matter				
		B	Fe	Mn	Zn	Cu
Local tall varieties	Fremond (1966)	-	50	60	60	-
	Kanapathy (1971)	-	50	60	60	-
	Friend (1975)	14	115	185	15	12
	Magat (1979)	9-11	-	-	-	-
	CRISL** (1988)	8	40-115	60-120	60	12-13
Dwarf varieties	Chew (1982)	8	40-45	60	-	-

Fertilizer Recommendations:

Age	Nutrient Rate (per tree)					
	N	P2O5	K2O	MgO	S	Cl
Field-planting	30 g	30 g	90 g	50 g	18 g	66 g
6 months	40 g	50 g	0.15 kg	85 g	25 g	0.11 kg
1 year	0.10 kg	0.10kg	0.35 kg	125 g	60 g	0.26 kg
2 years	0.15 kg	0.15 kg	0.55 kg	0.25 kg	90 g	0.40 kg
3 years	0.20 kg	0.16 kg	0.70 kg	0.35 kg	0.12 kg	0.53 kg
4 years	0.30 kg	0.20 kg	1.00 kg	0.40 kg	0.18 kg	0.70 kg
5 years and older	0.40 kg	0.30 kg	1.20 kg	0.50 kg	0.24 kg	0.90 kg

Source: Magat (1988)

The most common fertilizer combination is AS plus KCl thus supplying the four nutrients widely deficient in coconut soils: N, K₂O, Cl and S.

Timing and frequency of application

Pre-bearing stage (vegetative), usually 1-3 year old coconuts: annual rate/palm in split application, half at the start of rainy season and half 6 months after or about a month before end of the rainy season. In areas with almost even distribution of rainfall throughout the year, apply first half of fertilizer anytime and the remaining half 6 months later.

Bearing stage: annual rate/palm in a single application, for areas with an even rainfall distribution (1.5-3 dry months) or in split applications for areas with distinct dry and rainy seasons.

Method of fertilizer application

First, circle-weed (remove all weeds) around the base of the palm, with a radius of 0.5-0.75 m for young palms and 1-1.5 m for bearing palms. Then, broadcast the fertilizer to each tree as uniformly as possible over the circle-weeded area. Finally, incorporate the broadcast fertilizer (to a depth of 5-8 cm) with the use of a suitable digging tool. This is necessary for N fertilizers (like ammonium sulfate) to minimize losses due to volatilization.

On steeply sloping and hilly areas, place the fertilizer, equally distributed, in 10-12 holes (10-15 cm deep and 7-10 cm wide) within 1-2 m radius around the base of palm.

Present fertilizer practices:

Philippines (Southeast Asian Region)

Most coconut areas in the Philippines are widely deficient in N, Cl, S and K₂O and adequate in other nutrients. Generally, liming is not needed as coconut has a wide adaptability to soil acidity (pH 4.5-8).

Nursery - per seedling			
Age	Fertilizer combination		
	AS	either + KCl	or common salt (if K is not needed)
2	20 g	+ 25 g	+ 20 g
3	40 g	+ 45 g	+ 40 g
total	60 g	+ 70 g	+ 60 g

Field-planting to bearing stage - per tree			
Age	Fertilizer combination		
	AS	either + KCl	or + common salt (if K is not needed)
Coastal / within 2 km of coast)			
Field - planting	150 g	+ 100 g	+ 80 g
6 months	200 g	+ 150 g	+ 120 g
1 year	500 g	+ 500 g	+ 400 g
2 years	750 g	+ 750 g	+ 600 g
3 years	1.00 kg	+ 1.00 kg	+ 0.80 kg
4 years	1.25 kg	+ 1.25 kg	+ 1.00 kg
5 years or older	1.50 kg	+ 1.50 kg	+ 1.20 kg
Inland (over 2 km from coast)			
Field - planting	150 g	+ 200 g	+ 160 g
6 months	200 g	+ 250 g	+ 200 g
1 year	500 g	+ 600 g	+ 480 g
2 years	750 g	+ 900 g	+ 720 g
3 years	1.00 kg	+ 1.50 kg	+ 1.25 kg
4 years	1.25 kg	+ 1.70 kg	+ 1.35 kg
5 years or older	1.50 kg	+ 2.00 kg	+ 1.70 kg

Indonesia

The most common nutritional deficiency is N, followed by K and Mg. In certain areas, problems of Cl, P2O5, Ca and B exist (Mahmud and Allorerung, 1988). Current fertilizer recommendations widely used in the country are based on results of leaf analysis and soil analysis of field experiments and surveys.

Nursery - g per seedling				
Time	Fertilizers			
	Urea	TSP	KCl	Kieserite
Monthly	20	7.5	24	7.5

Source: Rompas, Lengkey and Mahmud, 1985

Bearing Stage - g per palm and year			
Province	Fertilizers		
	Urea	TSP	KCl
West Java	90 - 1700	0 - 1050	0 - 1750
Central Java	600 - 1700	0 - 1050	0 - 200
East Java	250 - 1400	0 - 625	0 - 100
West Kalimantan	750 - 1600	0	0 - 100
East Kalimantan	450 - 1500	0 - 450	0 - 500
South Kalimantan	480 - 1250	0	0
North Sulawesi	600 - 2200	0 - 1100	0 - 1500
Central Sulawesi	300 - 1350	0	0 - 1350

Source: Mahmud and Allorerung, 1988

Another fertilizer recommendation is based on altitude and soil type:

Soil type	Fertilizer in kg/palm and year		
	Urea	TSP	KCI
0 - 150 m above sea level			
Alluvial	1.10	0.20	1.30
Podzolic	1.20	0.30	1.60
Latosol	1.30	0.30	2.00
150 - 500 m above sea level			
Alluvial	0.90	0.60	1.30
Podzolic	1.00	0.90	1.60
Latosol	1.10	0.90	2.00
Source: Balittri Manado, 1984			

Malaysia

Nitrogen deficiency is common in all coconut soils, while P₂O₅, K₂O and MgO levels are inadequate in some areas, particularly on acid, peaty and sandy soils. The fertilizers used for high yielding hybrid coconuts in Malaysia are as follows:

Age (years)	Fertilizer in kg/palm and year				
	17-8-17	Urea	Rock phosphate	KCI	Ground magnesium limestone
Coastal clay soils					
1	1.00	-	0.50	-	0.5
2	-	1.00	1.00	1.00	1.0
3	-	1.75	1.50	1.50	1.5
4	-	1.50	-	1.50	2.0
5	-	1.50	-	1.00	-
6	-	1.50	-	1.00	-
7	-	1.50	-	1.00	-
8	-	1.50	-	1.00	-
Acid sulphate soil					
1	1.00	-	0.75	-	-
2	-	0.75	1.00	1.25	3.0
3	-	1.50	1.50	2.00	-
4	-	1.50	1.50	1.50	3.0
5	-	1.25	-	1.25	-
6	-	1.25	-	1.25	-
7	-	1.25	-	1.25	-
8	-	1.25	-	1.25	-
Source: Chew, 1982					

Sri Lanka

The widely deficient nutrients in the country are N, P₂O₅, K₂O and MgO. Countrywide, fertilizer application increases nut yield from 16 nuts to 72 nuts/tree per year (De Silva, 1981). The CRISL provides general fertilizer mixtures 13-12-17 and 12-6-32.

Young palms:

Age	kg per palm (13-12-17)
Field-planting	1.00*
6 months	0.50
1 year	0.60
1.5 years	0.60
2 years	0.80
2.5 years	0.80
3 years	1.00
3.5 years	1.00
4 years and up to bearing	1.20
* plus 1 kg dolomite + 10 kg dry cow dung per planting hole	

Adult palms:

Climatic Zone	Soil Type	kg per palm (12-6-32)
Wet (> 150 cm rainfall)	- gravel/cabook/sand	3*
	- loam or clay	2
Intermediate (100-150 cm rainfall)	- gravel/sand	3
	- loam or clay	2
Dry (< 100 cm rainfall)	- gravel	3
	- loam or clay	2
	- sand	2.5
* Plus dolomitic limestone at 2 kg/palm (wet zone); 1.5 kg/palm (in other areas) once in three years as a routine measure to meet Mg requirements.		

India

Based on fertilizer trials on West Coast Tall variety, Tall x Dwarf hybrids and Dwarf x Tall hybrids, general fertilizer recommendation (for palms yielding at least 50 nuts/palm per year) is as follows:

Condition	kg of nutrient per palm and year		
	N	P2O5	K2O
Rainfed/local talls	0.5 kg	0.3 kg	1.2 kg
Irrigated/hybrids	1 kg	0.6 kg	2.4 kg
Source: Nair, 1979			

Cote d'Ivoire (West Africa)

The main nutrients deficient are K2O, P2O5, MgO and N.

Stage	kg of fertilizer per palm and year			
	Urea	Single superphosphate	KCL	Kieserite
Year				
0	0.10	0.20	0.20	0.1
1	0.20	0.40	0.40	0.2
2	0.30	0.60	0.60	0.3
3	-	-	1.20	0.4
4	-	-	1.50	0.5
5	-	-	1.50	-
6	-	-	1.50	-
7 and over	-	-	1.00	-
Source: Zakra et al, 1986				

Further reading

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