

Yams (*Dioscorea spp*) and Cocoyams etc. (*Colocasia, Xanthosoma spp*)

French: Ignames & taro; Spanish: Names & taro; Italian: Ignames & taro; German: Yams & Taro

General Crop Data

Yams, one of the important staple food crops of the tropics, are particularly important in Africa which accounts for about 95 % of world production. Nutritionally they are rich in carbohydrate and are valuable sources of certain vitamins; they also contain 1.9-3.9 % protein.

In addition, precursors of Cortisone and related steroidal drugs are derived directly from some wild species (e.g. *Dioscorea floribunda*). Large scale cultivation for food is restricted largely to West Africa, Eastern Asia and the Caribbean region. In India they are grown only as a supplement to cereals.

Main edible species: *D. esculenta*, *D. alata*, *D. rotundata*.

Elephant yams (*Amorphophallus campanulatus*), not a species of *Dioscorea*, are usually consumed locally where they are grown, and are particularly important in India and Indonesia.

Amorphophallus rivieri is grown commercially in Japan for the production of mannose sugar.

Cocoyams are considered as subsistence and emergency food sources in many parts of the world, but in South Pacific islands and in some parts of Asia they are used as a major staple food crop.

Thanks to the high digestibility and very small size of starch granules from *Colocasia* (taro, old cocoyam), this crop can provide a good base for babyfoods, and the leaves are an excellent vegetable. It is a versatile crop which can be grown in both lowland and upland conditions.

Xanthosoma sp (tannia), unlike *Colocasia*, cannot stand waterlogging but it is a partial shade-loving crop. The cormels are rich in carbohydrates.

Individual Crop Data

***Dioscorea esculenta* (Lour) Burk.**

English: Lesser yam, Lesser Asiatic yam, Chinese yam; French: Igname des blancs

Annual. Harvested part: tubers.

Planted: March/April (India), December/February (Africa).

Harvested 8 months after planting.

Plant density 12 500-17 000 plants/ha.

Prefers light friable sandy or gravelly soil, well drained and rich in organic matter. Generally rainfed.

***Dioscorea alata* L.**

English: Greater yam, Water yam, Winged yam; French: Igname de Chine

Annual. Harvested part: tubers.

Planted: March/April (India), December/February (Africa).

Harvested 9-10 months after planting.

Plant density 10 000-12 500 plants/ha.

Can tolerate poorer soils than most other edible yams. Sandy loams suit very well. Responds well to manuring. Generally rainfed.

Dioscorea rotundata Poir

English: White yam, Guinea yam, Eight months yam; Spanish: Name blanco

Annual. Harvested part: tubers.

Planted: March/April (India), December/February (Africa).

Harvested 9-10 months after planting.

Plant density 10 000-12 500 plants/ha.

Prefers heavy soils and can tolerate high clay content.

Generally unirrigated.

Amorphophallus campanulatus (Roxb) Bl.

English: Elephant foot yam, Elephant yam, Sweet yam;

Annual. Harvested part: underground corms.

Planted: March/April (India):

Harvested 10 months after planting.

Plant density 10 000-12 500 plants/ha.

Prefers deep loamy soil worked to a fine tilth, not alkaline. Good drainage essential.

Generally rainfed, but responds to irrigation.

Colocasia esculenta (L) Schott.

English: Taro, Old cocoyam; French: Taros; Spanish: Malanga (Colocasia)

Annual. Harvested part: corm and cormels.

Planting time not a major factor provided moisture and sunlight adequate, but, if rainfed, should be timed to precede or coincide with rainy season.

Harvest time depends on cultivar and method of cultivation, ranging from 6-8 months after planting (India, Nigeria) to 12-15 months after planting (Hawaii).

Plant density 27 000-49 000 plants/ha.

Grown in all kinds of soil types but prefers deep, well drained, friable loams, especially alluvial loams with high water-table. pH 5.5-6.5 preferred. Primarily adapted to moist environment but can be grown in wide range of conditions.

Xanthosoma sagittifolium (L.) Schott

English: Tannia, New cocoyam; French: Tannie, Chou caraibe; Spanish: Malanga amarilla, Mangarito

Annual. Harvested part: corm and cormels.

Planting time depends on adequate moisture; can be planted throughout the year where water supply is assured.

Harvested 9-12 months after planting.

Plant density 12 345-27 000 plants/ha.

Prefers deep well drained soils with pH 5.5-6.5. Can tolerate saline soils, but not water logging. Should be irrigated in the absence of adequate rainfall to produce high yields.

Nutrient demand/uptake/removal

Nutrient uptake/removal - Macronutrients								
Species	Tuber yield t/ha	Source	kg/ha					
			N	P2O5	K2O	MgO	CaO	S
Dioscorea alata (Greater yam)	35.95	Obigbesan and Agboola, 1978	128.6	38.9	195.0	18.7	5.6	-
	18.60	Kabeerathu mma et al, 1987	75.0	21.3	108.8	6.5	16.3	-
Dioscorea rotundata (White yam)	26.90	Sobulo, 1972	205.0	29.8	135.0	-	-	-
	51.60	Irizarry and Rivera, 1985	189.0	57.3	259.0	61.0	127.4	-
	30.00	Kabeerathu mma et al, 1987	91.2	34.4	124.9	9.8	25.8	-
	37.90	Obigbesan and Agboola, 1978	148.0	41.2	199.2	18.6	5.6	-
D. esculenta (Lesser yam)	17.87	Kabeerathu mma et al, 1987	73.0	25.8	77.3	10.5	19.8	-
D. cayenensis (Yellow yam)	45.13	Obigbesan and Agboola, 1978	139.0	43.5	218.0	22.0	5.6	-
Amorphophallus campanulatus (Elephant foot yam)	33.0	Kabeerathu mma et al, 1987	100.0	37.9	267.1	18.6	38.2	-
Colocasia esculenta (Taro)	17.0	Kabeerathu mma et al, 1987	59.5	26.4	71.4	8.9	11.5	4.5
	12.3	Mohankumar, 1986	(124.8) 29.0	(44.0) 10.3	(162.0) 37.2	(26.8) -	(45.6) -	(11.8)* -
	34.9	Portieles et al, 1982	(59.1) 153.4	(18.1) 115.2	(86.4)* 422.3	- -	- -	- -
Xanthosoma sp. -Corm + cormel -Edible cormel	21.1	Vicente-Chandler et al, 1982	100.0	28.6	145.2	40.0	18.2	-
	11.5		(125.0)	(37.0)	(187.0)	(52.4)	(35.0)*	-

* Figures in parenthesis indicate total uptake inclusive of both tuberous and non-tuberous portion.

Nutrient uptake/removal - Micronutrients						
Species	Tuber yield t/ha	Source	g/ha			
			Fe	Mn	Zn	Cu
Dioscorea alata (Greater yam)	18.60	Kabeerathumma et al, 1987	1 400	180	134	157
Dioscorea rotundata (White yam)	30.00	Kabeerathumma et al, 1987	3 000	334	290	267
D. esculenta (Lesser yam)	17.87	Kabeerathumma et al, 1987	2 000	320	280	114
Amorphophallus ampanulatus (Elephant foot yam)	33.0	Kabeerathumma et al, 1987	3 920	530	490	90
Colocasia esculenta (Taro)	17.0	Kabeerathumma et al, 1987	1 186 (10250)	370 (1690)	327 (647)	37 (93)*

* Figures in parenthesis indicate total uptake inclusive of both tuberous and non-tuberous portion.

Plant analysis data

Plant analysis data - Macronutrients									
Species	Plant part	Stage of growth	Source	% of dry matter					
				N	P	K	Mg	Ca	S
Dioscorea esculenta	Leaf with petiole	3rd month	Kabeerathu mma et al, 1987	1.85	0.18	1.46	0.22	0.47	-
	First fully matured leaf with petiole	5th month	Vanderzaag et al, 1980	2.70	0.39	2.60	0.23	1.10	0.15
D. alata	Leaf with petiole	3rd month	Kabeerathu mma et al, 1987	1.86	0.20	2.27	0.26	0.65	-
	Lamina/petiole	4th month	Obigbesan and Agboola, 1978	3.71	0.38	4.80*P	0.28	1.05	-
	First fully matured leaf with petiole	4th month	Vanderzaag et al, 1980	2.90	0.22	3.1	0.33	1.8	0.17
D. rotundata	Leaf with petiole	3rd month	Kabeerathu mma et al, 1987	1.94	0.16	2.02	0.27	0.54	-
	First fully matured leaf with petiole	4th month	Kang and Wilson, 1981	2.94	0.19	0.96	-	2.82	-
	Lamina/petiole	4th month	Obigbesan and Agboola, 1978	3.4	0.30	4.0*(P)	0.27	0.7	-
	First fully matured leaf	4th month	Abruna et al, 1982	3.1	0.10	2.11	0.42	1.68	-
Amorphophallus campanulatus (elephant foot yam)	Leaf blade	5th month	Kabeerathu mma et al, 1987	4.05	0.55	3.82	0.33	0.65	-
Colocasia esculenta	Fully expanded leaf	4th month	Mohankumar, 1986	3.67 (3.0)	0.36 (0.34)	2.43 (2.0)	-	-	-
	Lamina	3rd month	Kabeerathu mma et al, 1987	3.67	0.37	3.50	0.55	0.80	0.33
	Leaf blade of upland taro	3rd month	De la Pena & Plucknett, 1976	4.45	0.32	5.07	0.19	1.20	-
	Leaf blade of lowland taro	6th month	De la Pena & Plucknett, 1976	4.96	0.57	4.53	0.62	1.43	-
	Leaf blade of 3 rd or 4 th leaf	2nd month	Miyasaka and Bartholomew, 1979	-	-	-	-	0.4 (CYV)	-
	Leaf of flooded taro	4th month	De la Pena et al, 1979	-	0.4 (OS)	-	-	-	-
	3rd leaf	3rd month	Leucas et al, 1977	4.5 (CYV)	0.56 (OS)	6.2 (CYV)	0.09 (D)	0.55 (D)	50 ppm as sulphate sulphur (D)
				1.8 (D)	0.4 (CVY)	1.5 (D)			
Xanthosoma sp.	Lamina	6th month	Vicente - Chandler et al, 1982	3.2	0.5	2.3	0.9 (0.3) (0.9) (OS)	1.3	-

	3rd & 4th leaf	-	Abruna et al, 1982	3.07	0.23	2.65	0.56	1.25	-
D = Deficiency OS = Optimum supply CVY = Critical value (yield) P = petiole analysis									

Fertilizer Recommendations

Response to fertilizers depends mainly on the native fertility of the soil as well as the variety in cultivation. In traditional bush fallow agriculture in West Africa, yams were usually grown during the first season after clearance from bush, thus obtaining reasonably good yields without using fertilizer. However, as land scarcity causes the fallow period to be shorter, so yields decrease progressively, and traditional farmers will need less persuasion to use fertilizer on their yams. Also, despite the widespread belief that fertilizer causes rapid deterioration of tubers in storage, Umanah (1973) could find no significant effect of applied fertilizer on weight loss or decay of tubers. On the contrary, application of P₂O₅ and K₂O has been found to enhance storage life by decreasing sprouting in storage. In general, yams respond well to N, P₂O₅ and K₂O. Response to P₂O₅ has been reported to be slight, partly on account of its low requirement and partly due to mycorrhizal fungi which help the roots to absorb P effectively from the soil. For this reason some of the earlier recommendations ignored or underestimated P₂O₅. Characteristic recommendations were: in Nigeria 125-250 kg/ha compound fertilizer (e.g. 20:0:20, 10:10:20, 12:12:18) or ammonium sulphate only: in Trinidad 400 kg/ha 11:11:13 or 200 kg/ha ammonium sulphate. Recommendations for individual species according to yield level and region are given below.

Owing to the shallow rooting system of yams, split application of N and K₂O is advised: e.g. the first dressing one month after sprouting, and the second about 7-12 weeks after germination, depending on the availability of rain, or 3-5 months after planting. With mound planting, the fertilizer should be applied in a ring of about 15 cm radius around the plant. With ridge planting, it should be applied in a continuous band along the row about 10 cm away from the plants. The use of mulch is beneficial. Capping mounds with dry leaves or straw keeps the soil cool and minimizes moisture loss. In India addition of ash from burnt trash, with f.y.m. and dry leaf mulch is a common practice; 10-12 t/ha f.y.m. is beneficial. For elephant yams f.y.m. is applied at 25 t/ha, and a mulch of green leaves at 4-5 kg/plant.

For cocoyams, pig manure and cowdung were the organic manures commonly used. Fertilizer use was restricted by the belief that it results in the production of soft, watery corms with a lower market value; and palatability was found to be affected by high rates of fertilizer use. Evidence suggests, however, that these ill effects occur only when fertilizer is applied too late in the growth cycle. At least 3 months should be allowed between the application of the last dressing and harvest. Yield responses of cocoyams to fertilizer vary with soil conditions and method of cultivation: several reports of good responses have been published. Mulching is commonly practised; a mulch of 10-12 t/ha green manure has been reported to be particularly beneficial.

Preferred fertilizers used

N - urea or ammonium sulphate,
P - single and triple super phosphate,
K - mainly supplied as chloride; can also be supplied as sulphate.

Fertilizer recommendations for individual species:

Dioscorea esculenta

	Kg/ha			
	N	P2O5	K2O	MgO
(medium yield 15-20 t/ha, Kerala, India)				
On lateritic sandy clay loam (ultisol)				
Within 1 week after sprouting	40	60	40	-
One month later	40		40	-
On forest soil rich in organic matter:				
Within 1 week after sprouting	30	60	45	-
One month later	30		45	-

Dioscorea alata

	kg/ha			
	N	P2O5	K2O	MgO
(medium yield 12 1/2-25 t/ha, Kerala, India)				
On lateritic sandy clay loam (ultisol):				
Within 1 week after sprouting	40	60	40	-
One month later	40		40	-
(high yield > 25 t/ha, Puerto Rico)				
On acid corozal clay soil (aquic tropodults), limed to pH >5.5:				
At planting	500 kg/ha 10:10:10 mixture containing 30 kg/t of a mixture of 6 % Mg, 7.7 % Mn, 4.8 % Cu, 7 % Fe, 8 % Zn and 2.5 % B.			
After 5 months	500 kg/ha of same mixture			

Dioscorea rotundata

	kg/ha			
	N	P2O5	K2O	MgO
(low yield < 15 t/ha, Nigeria)				
On gravelly sandy loam:				
At planting	-	13	25	-
4 weeks after planting	30	-	-	-
10 weeks after planting	30	-	-	-
On light loamy ultisol:				
8 weeks after planting	35	25	40	-
(medium yield 25-30 t/ha, Kerala, India)				
On lateritic sandy clay loam (ultisol):				
Within 1 week after sprouting	40	60	40	-
One month later	40	-	40	-
(high yield > 30 t/ha, Puerto Rico)				
On Corozal clay soil (ultisol):				
2 months after planting	112	34	129	28
5 months after planting	112	34	129	28
Use of a 14:3:13:3 compound fertilizer is considered suitable.				
On Coto soil (oxisol):				
1 month after planting	102	34	85	-
3 months after planting	102	-	85	-

Amorphophallus campanulatus

	kg/ha			
	N	P2O5	K2O	MgO
(Kerala, India) On lateritic sandy clay loam (ultisol):				
2 weeks after germination	50	50	75	-
1 month later	50	-	75	-
Mulching with 10-12 t/ha green leaves is common practice.				

Colocasia esculenta

	kg/ha			
	N	P2O5	K2O	MgO
Upland (high yield, 6-7 month crop, Kerala, India) On sandy clay loam soil with medium fertility:				
1 month after sprouting	40	50	50	-
One month later	40	-	50	-
Upland (high yield, 12 months crop, Hawaii) On humic latosol:				
At planting	187	280	93	-
2 months after planting	187	-	93	-
4 months after planting	187	-	93	-
Lowland (high yield, 15 months crop, Hawaii) On lowland paddy with yield potential > 50 t/ha:				
At planting	373	280	93	-
2 months after planting	373	-	93	-
4 months after planting	373	-	93	-
Lowland (high yield, Philippines) On soil with yield potential 30-40 t/ha:				
At planting	30	15	30	-
2 months after planting	30	15	30	-

Colocasia, improved varieties

	kg/ha			
	N	P2O5	K2O	MgO
Johore Region, Malaysia 9-11 months crop on peat soil:				
1 month after planting	46	21.5	46	-
3 times at 5-weekly intervals	46	16	23	2.7
6 1/2 months after planting	N = 85 (as ammonium sulphate)			
Perak Region, Malaysia;				
1 month after planting	40	40	40	-
3 times at 5-weekly intervals	20	20	20	-
6 1/2 months after planting	85 (as ammonium sulphate)			
Fiji (Upland) On humic latosol and alluvial soils with yields of 20-24 t/ha:				
6 weeks after planting	50	25	100	-
12 weeks after planting	50			

Xanthosoma sp.

	kg/ha			
	N	P2O5	K2O	MgO
(medium yield, Kerala, India) On lateritic sandy clay loam (ultisol): 1 month after sprouting	40	50	50	-
One month later	40	-	50	-
(medium yield, Puerto Rico) On Corozal clay soil, pH 5.8 : At planting	500 kg/ha 10:10:10 mixture containing 30 kg/t of a mixture of 6 % Mg, 7.7 % Mn, 4.8 % Cu, 7 % Fe, 8 % Zn and 2.5 % B.			
After 6 months	500 kg/ha of same mixture			
On clay soil (Vertic eutropepts): 2 months after planting	500 kg/ha 10:5:15:3 mixture			
6 months after planting	500 kg/ha of same mixture			

Further reading

Guide to the production of Yam. Ahmadu Bello University Extension and Research Liaison Service, Extension Guide No. 11, Ahmadu Bello, Nigeria (1971)

COURSEY, D.G.: Yams. Longmans, London, England, 230pp.(1967)

KABEERATHUMMA, S.; MOHANKUMAR, B.; NAIR, P.G.: Nutrient uptake and their utilization by yams aroids and coleus. Tech. Bull. Series 10, CTCRI, Thiruvananthapuram, Kerala, India (1987)

ONWUEME, I.C.: The tropical tuber crops. John Wiley and Sons, New York, USA (1978)

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