Groundnut *[Peanut] (Arachis hypogaea L.)*

French: Arachide; Spanish: Mani, cacahuete; Italian: Pistacchio di terra; German: Erdnuss; Portugese: Amendoim

Crop data

Grown as an annual but perennial growth is possible in climates which are warm until harvest. Types grown include: Runner, Spanish, Virginia, Valencia. It is a traditional smallholder low-input crop in W.Africa and a major cash crop on both small and large farms in India, China and USA. The fruits (nuts) are used for human food as peanut oil, peanut butter, candy and roasted, boiled and raw peanuts, etc. Shells (hulls) are a by-product residue sometimes used as fuel, e.g. for generation of electricity. Aboveground forage (hay or vines) often used for livestock feed.

Sown late spring, after soil temperatures warm in cool climates (15 April - 15 May in Southern USA), generally at 100-150 kg/ha in rows approx. 80-100 cm wide at depth of 3-8 cm dependent on moisture availability in the topsoil.

Flowering occurs 30-45 days after planting and continues for several weeks. Harvest of mature pods 120-145 days after planting.

Desirable plant densities: small-seeded types, approx. 160 000 plants/ha; large-seeded types, 125 000 plants/ha; late-maturing types in W.africa, 110 000 plants/ha.

Adapted to semi-arid and semi-humid conditions. The main growing areas receive 500-1 200 mm annual rainfall. Rain during the growing season is critical for good fruit development. The crop responds to irrigation when very dry conditions occur at planting or from flowering to maturity.

Prefers loose sandy soils, of types ranging from loamy sands to sandy clay loams, with good drainage. Soil pH can range from 5 to 7.8 but nutrient deficiencies and/or toxicities can be expected at the extremes of this wide range. The preferred pH range is 5.5-6.5. Deep tillage is favoured in order to bury residues from the previous crop, and for best development and easy recovery of the pods.

Methods of culture vary from planting on raised beds (in Southern USA), to flat planting, hole planting (in China) and ridge planting (in other parts of the world).

Nutrient demand/uptake/removal

Varies with yield, nutritional status and parts removed at harvest. Because of the high proportion of nutrients in the vines, the removal of nutrients is much less if the vines are returned to the soil than if they are removed. The relative proportions of macronutrients in various parts of mature plants are:

Partitioning of macro-nutrients at harvest					
Plant part	**Percentage of total**				
	N	**P**	**K**	**Mg**	**Ca**
Vines	46	41	65	70	88
Roots	9	11	8	14	7
Kernels	40	42	17	11	3
Hulls	5	6	10	5	2
Source: Longanathan and Krishnamoorthy, 1977					

Calculations of removal per hectare in USA, China and Senegal give rather similar figures when the differing yield levels are taken into account:

Nutrient removal - Macronutrients						
Country(pod yield)	**Plant part**	**kg/ha**				
		N	**P2O5**	**K2O**	**MgO**	**CaO**
USA (3 t/ha)						
	Pods	120	24	22	-	8
	Vines	72	24	58	-	71
	Total	192	48	80	-	79
China (1.023 t/ha)						
	Kernels	38	8	3	7	2
	Hulls	3	1	5	3	4
	Leaves	16	3	4	16	21
	Stems	7	2	5	15	9
	Total	64	14	17	41	36
(2.250 t/ha)	Total	150	30	82	-	91
(3.975 t/ha)	Total	195	38	90	-	-
(5.085 t/ha)	Total	259	49	124	-	256
(5.310 t/ha)	Total	270	55	165	-	261
Senegal - mean from 3 regions		48	7	15	8	10
Sources: Morrison, 1959; Univ. of Florida, 1967-76; Crop ecology group, Inst. of Botany, Acad. Sinica, 1977; Wang Zaixu, Sun Yanbao et al., 1982; Gillier & Silvestre, 1969.						

Only 10-20 % of the total uptake of nutrients occurs during the vegetative stage, the remainder being divided about equally between the reproductive and ripening stages:

Partitioning of total uptake of macronutrients by growth stage					
Growth stage	**Percentages of total uptake**				
	N	**P**	**K**	**Mg**	**Ca**
Vegetative	10	10	19	11	10
Reproductive	42	39	28	48	53
Ripening	48	51	53	41	37
Source: Adapted from Longanathan & Krishnamoorthy, 1977					

Plant analysis data

Leaf analysis is not well accepted as a good diagnostic tool for groundnuts; the final yield and quality of nuts do not generally relate well to leaf composition during growth. One factor that is probably involved is the restricted downward phloem movement of nutrients from the above-ground plant parts to the developing pods. However, leaf analysis is still important as a gauge of the nutritional health of the plant through much of its development.

Careful attention to plant age is necessary when interpreting foliar nutrient concentrations. Cox et al (1970) found that N and P concentrations decreased steadily from plant age 2 to 21 weeks; K increased nearly a full percent from week 2 to week 6 before decreasing slightly with further age; Ca and S were erratic but did not decrease significantly over the whole time period; Mg tended to increase slowly to weeks 10-12 and then decrease slightly; Mn decreased slightly throughout; Zn increased to week 6, then decreased markedly to week 21; Cu and B changed only slightly.

Sufficiency ranges are:

Plant analysis data (sufficiency levels for leaves) - Macronutrients							
Plant par	**Time**	**% of dry matter**					
		N	**P**	**K**	**Mg**	**Ca**	**S**
7th leaf	40 DAP	3.3-3.9	0.15-0.25	1.0-1.5	0.30	2.0	0.19-0.25
Upper mature leaves	Bloom	3.0-4.5	0.20-0.50	1.7-3.0	0.30-0.80	1.25-2.0	0.20-0.35
Sources: Gillier & Silvestre, 1969; Plank, 1989							

Plant analysis data (sufficiency levels for leaves) - Micronutrients								
Plant part	**Time**	**ppm dry matter**						
		Ma	**Fe**	**B**	**Cu**	**Zn**	**Al**	**Mo**
Upper mature leaves	Bloom	20-350	50-300	20-60	5-20	20-60	<200	0.1-5.0
Sources: Gillier & Silvestre, 1969; Plank, 1989								

Data from China for various plant parts at different stages of development are shown below.

Plant analysis data (China) - Macronutrients						
Plant part	**Time**	**% of dry matter**				
		N	**P**	**K**	**Mg**	**Ca**
Leaf	Bloom	3.97	0.09	1.06	1.87	2.07
Leaf	Maturity	2.95	0.26	0.65	1.79	2.
Stem	Flowering	1.58	0.22	2.17	1.03	1.11
Stem	Maturity	1.15	0.12	0.79	1.63	1.12
Pod	Maturity	1.20	0.25	1.20	0.85	1.20
Seed	Maturity	4.76	0.46	0.24	0.58	0.17
Plant	Seedling	3.94	0.19	1.52	-	0.63 (root) 1.20 (leaf)
Plant	Flowering	3.86	0.23	1.31	-	0.76 (root) 1.64 (leaf)
Plant	Flowering	3.48	0.24	1.64	-	2.11 (leaf) 0.49 (young pod)
Plant	Maturity	3.70	0.28	1.59	-	2.70 (leaf) 0.89 (pod)
Plant	Maturity	2.52 2.61	0.17 0.22	0.86 0.79	0.43 0.41	0.53 unfertilized 0.48 fertilized
Source: Academia Sinica, 1977; Wang Zaixu et al., 1982; Cai Changbei, 1988.						

Plant analysis data (China) - Micronutrients				
Plant part	Time	ppm dry matter		
		Mn	Fe	B
Leaf	Bloom	-	200	-
Leaf	Maturity	70	63	-
Stem	Flowering	19	97	-
Stem	Maturity	17	198	-
Pod	Maturity	19	85	-
Plant	Seedling	-	-	25
Plant	Flowering	-	-	24
Plant	Flowering	-	-	23
Plant	Maturity	-	-	19
Source: Academia Sinica, 1977; Wang Zaixu et al., 1982; Cai Changbei, 1988.				

Some workers believe that nutrient ratios are more important than individual concentrations. Roche et al (1959) recommended ratios in the leaves of N: (N+P+K) = 0.5 to 0.65, P: (N+P+K) = 0.03 to 0.05 , and K: (N+P+K) = 0.32 to 0.40.

Since Ca is especially important for nut development, it has received considerable attention. Gaines et al (1991) found maximum yield and grade for the small-seeded runner type with 0.12 % Ca in the hulls and 0.04 % Ca in the nuts, and for the large-seeded Virginia type with 0.19 % and 0.058 % respectively.

Fertilizer recommendations

Preferably based on soil tests. If pH is low and liming is recommended, limestone should be broadcast and turned into the soil in early spring.

Most USA research indicates no response to N when the soil is limed to an adequate pH and inoculated with the correct Rhizobium sp. On the other hand, many responses to N have been obtained in other countries.

Few responses to P and K have been recorded in USA since the rotational crops usually have higher requirements. Responses have been reported, however, under very low fertility conditions in Africa and in particular in soils with high P fixation. Basal applications of P and K (and of N too in several countries) are usually broadcast and incorporated into the soil before planting. Some topdressings of small amounts of N are applied at the vegetative stage in China. Gypsum application (to supply Ca and S), by broadcasting or banding at flowering, is common. B and Mo are commonly applied in foliar sprays at the vegetative stage.

Preferred nutrient forms

Available organic manures are often applied and incorporated before planting. However, undecomposed organic matter may result in problems of germination and seedling disease if not buried. Generally most of the fertility is supplied by inorganic fertilizers including urea, concentrated superphosphate, and muriate of potash either as single nutrient fertilizers or in blends. Ca and Mg are supplied in limestone and/or Ca and S as gypsum. B and Mo, when applied, are commonly foliar sprays of soluble compounds.

Present fertilizer practices

USA

Limestone broadcast and turned into the soil before planting if pH < 5.5-6.0. P and K broadcast and incorporated before planting at rates of 45-90 kg/ha P_2O_5 and 50-95 kg/ha K_2O depending on soil test. Also Mg at 50 kg/ha MgO if soil test is low and limestone is not applied.

Gypsum applied at bloom to small-seeded types, when Mehlich 1 extractable Ca < 150-250 mg/kg or Ca:Mg ratio < 3:1, broadcast at 250-315 kg/ha CaO or at proportionally lower rates for band application covering a smaller surface area. Double rates of gypsum applied to all large-seeded peanuts, regardless of Ca soil test.

Boron at 0.6 kg/ha B (unless soil level > 0.5 mg/kg B) usually in foliar sprays, split between the first two fungicide applications.

W. Africa

Recommendations from research are applied only where credit, subsidy and adequate supply are available.

For sowing on flat: fertilizer side-dressed or broadcast before 10th day of vegetation (drier areas).

For sowing on ridges: natural vegetation, and sometimes dry manure, buried at ridging and fertilizer side-dressed before 10th day of vegetation (frequent in wet areas with over 900 mm rainfall).

In Senegal: generally a basal dressing of 9-30-15 fertilizer.

In other countries: generally single superphosphate (60-100 kg/ha) or sulphate of ammonia and dicalcium phosphate; when available, cotton fertilizer is sometimes used.

Rock phosphate, available in many W. African countries, is being tested experimentally, either treated industrially to make it more soluble or applied as a basal fertilizer dressing.

The official quantities recommended are:

Senegal: 150 kg/ha 9-30-15, plus 400 kg/ha gypsum as a topdressing on seed multiplications of confectionery varieties 40 days after planting.

Burkina Faso: 75 kg/ha single superphosphate.

Tchad and Niger: 100 kg/ha single superphosphate.

Guinea-Bissau: 100 kg/ha 14-22-12 cotton fertilizer.

India

Fertilizer recommendations concerning the seven major oilseed growing states are given in the table below.

State	recommended rates (kg/ha)						farmyard manure t/ha	Gypsum kg/ha
	Rainfed			Irrigated				
	N	P2O5	K2O	N	P2O5	K2O		
Andhra Pradesh	20	40	20	30	40	50	10	500
Gujarat	12.5	25	0	25	50	0		
Karnataka	25	50	25	25	75	25-37		500
Madhya Pradesh	20	80	80	20	80	80	10	200
Maharashtra	12	25	0	25	50	0		
Rajasthan	15	60	0	15	60	0		
Tamil Nadu	10	10	45	17	34	54	12.5	250
Source: Tandon, 1990.								

China

For traditional varieties in North China with an expected pod yield of 3 000 kg/ha: 22.5 t/ha organic manure plus fertilizer containing 20 kg/ha P2O5, banded in the seed row and incorporated in the upper 10 cm of soil, followed by a topdressing of 30 kg/ha N.

For improved varieties on medium soils in the Province of Shan-Dong with an expected pod yield of 4 500 kg/ha: basal application at sowing time of 37.5 t/ha organic manure plus fertilizer containing 30 kg/ha P2O5 and 75 kg/ha K2O, and inoculation with groundnut Rhizobium, followed by first topdressing at seedling stage of 30 kg/ha N and second topdressing at first bloom of 10 kg/ha N.

Further reading

COX, F.R.; ADAMS, F.; TUCKER, B.B.: Liming, fertilization, and mineral nutrition. In: PATTEE, H.E.; YOUNG, C.T. (eds.): Peanut Science and Technology. American Peanut Research and Education Society, Inc., Yoakum, Texas, USA (1982)

GILLIER, P.; SILVESTRE, P.: Fertilisation. In: L'Arachide. G.P. Maisonneuve et Larose, Paris, France (1969)

MAZZANI, B.: El Cultivo, Abonos. In: El Mani en Venezuela. Centro de Investigaciones Agronomicas, Maracay, Venezuela (1961)

REID, P.H.; COX, F.R.: Soil properties, mineral nutrition and fertilization practices. In: Peanuts, Culture and Uses. American Peanut Research and Education Association. Oklahoma State University, Stillwater, Oklahoma, USA (1973)

YORK, E.T., Jr.; COLWELL, W.E.: Soil properties, fertilization and maintenance of soil fertility. In: The Peanut, the Unpredictable Legume. The National Fertilizer Association, Washington D.C., USA (1951)

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