

GROUNDNUT (PEANUT/MONKEY NUT)

Botanical name: *Arachis hypogea* L. *Arachis hypogea* is derived from two Greek words "Arachis" meaning to legume and "hypogea" meaning below ground, referring to the formation of pods in the soil.

Family : Leguminosae

Origin : Recent botanical survey has indicated that Brazil in South America is the most likely center of origin of this plant. In India, Jesuit Father (Missionaries) introduced it in first half of the 16th century. It was introduced in Gujarat by Shri Padmabhai Patel of Pipaliya village, taluka dhoraji(Rajkot) in 1910 from Tamil Nadu.

It is also known as **peanut, earthnut, monkey nut, manilla nut, pinda, goober and kingpin of oilseeds**, unpredictable legume and energy capsule.

Groundnut is a herbaceous annual with more or less upright central stem with numerous branches that vary from prostrate to almost erect depending upon the variety. It has a taproot; stem is cylindrical, hairy and become more or less angular with age. The leaves of groundnut are pinnate with two pairs of leaflets borne on a cylindrical and grooved petiole. The flowers are yellow, complete, papilionate and sessile. Usually flowering takes place between 24-30 days after sowing, which is little earlier in bunch type than spreading. The flowers open between 6-8 am and fertilization is completed before mid day. The gynophore is commonly referred to as **peg**. The peg carrying the ovary pushes itself into the soil. It is only after entering the soil that ovary begins to develop and takes up horizontal position. At the same time, the pod begins to enlarge. The fruit is a indehiscent pod containing 1-5 seeds. The shell of the pod which contains the seed is morphologically the pericarp and the thin skin that covers the seed or nut is the test. The nut is composed of 2 cotyledons, which contain oil and other food materials.

Area and distribution

World production of groundnut reached a record of about 21 million tonnes. The most important groundnut producing countries in the world are India, China, USA, West Africa, Sudan, and Nigeria etc. India ranks first in the world in area (8.5 million hectares contributes about 40 % of the total world's area) and production (8.4 million tonnes contributes about 33 % of the total world's production). The average productivity of India is only about 988 kg/ha as against 2995 kg/ha in USA, 2688 kg/ha in China, 1379 kg/ha in Brazil, 1360 kg/ha in Indonesia and 1145 kg/ha in Nigeria.

Among all oilseed crops, groundnut accounts for more than 40-50 % in area and 60 to 70 % in production in the country. Among oilseed crops, groundnut has first place in the country. In India, it is grown in an area of about 85 lakh hectares with the total production of 84 lakh tonnes. Its cultivation in India is mainly confined to the States of Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra, Madhya Pradesh, Uttar Pradesh, Rajasthan,

Punjab and Orissa. About 80 % of the total area and 84 % of the total production in the country are confined to first five States. The highest productivity of groundnut (1604 kg/ha) is in State of Tamil Nadu, while in Gujarat the productivity is about 1190 kg/ha.

Table shows the position of the States with respect to area, production and productivity

Area	Production	Productivity
Gujarat	Gujarat	Tamil Nadu
Andhra Pradesh	Tamil Nadu	Gujarat
Karnataka	Andhra Pradesh	Punjab
Maharashtra	Karnataka	Andhra Pradesh
Tamil Nadu	Maharashtra	Uttar Pradesh

In Gujarat, groundnut is grown in an about 20 lakh hectares area with total production of about 26 lakh tonnes annually. In Gujarat State, groundnut is grown mainly in the districts of Junagadh, Amreli, Rajkot, Bhavnagar, Jamnagar and Sabarkantha etc. Saurashtra is the heart of the Gujarat and India for groundnut production.

Economic importance

The kernels are consumed either roasted or fried and salted. Groundnut kernel contains about **47-49 %** oil and **20 %** protein. Its kernel as a whole is highly digestible. The kernels are eaten as either roasted or fried and salted. The biological value of the groundnut protein is among the highest of the vegetable protein and equals that of casein. Groundnut oil is famous for use in human diet and Gujarati peoples like it more in preparation of their foods as compared to other edible oils. Groundnut oil is primarily used in the manufacturing of vegetable ghee. Groundnut is a good source of all B vitamins except B₁₂. They are a rich source of thiamin, riboflavin, nicotinic acid and vitamin E. 1 g kernel supplies 5-8 food calories.

The oil cake obtained after the extraction of the oil is a valuable organic manure and animal feed. It contains **7-8 % N, 1.5 % P₂O₅ and 1.5 % K₂O**. It is a good rotation crop being legume as it build up the soil fertility by fixing atmospheric nitrogen through root nodules which adds about 12 to 40 kg N/ha and also act as a efficient cover crop for land exposed to soil erosion. The per capita consumption of edible oils in India is about 5 kg/annum, which is far less than the world average of about 13 kg and one fourth of 20 kg/capita consumption in developed countries. Plant haulm used as valuable foods. Shell is used for fuel, thus it is four fold crop i.e. food, fodder, feed and bio-fertilizer.

Groundnut is classified as under:

1) According to Waldron or Growth habits.

- a) **The erect or bunch type:** include *Arachis hypogea* sub species *fastigiata* short duration (95-105), early maturing, and high yielding and almost free from dormancy, high germination percentage (90-95).
- b) **The spreading or trailing type:** include *Arachis hypogea* sub species *procumbens*. *Lal.* Long duration (110-120 days), late maturity, high yielding ability and have dormancy (60-75%), low germination per cent (85-90).

2) Classification according to specialist of Tamil Nadu state:

Cultivated *Arachis hypogea* has been classified into 5 varieties based on habit of growth, taste, colour, size or other characters of pods, leaf characters.

- i) *Arachis hypogea* var. *oleifera*
- j) *Arachis hypogea* var. *mambyquare*
- k) *Arachis hypogea* var. *rasteiro*
- l) *Arachis hypogea* var. *asiatica*
- m) *Arachis hypogea* var. *gigantia*

3) Commercial classification of groundnut

- a) Coromandal type: It bears smaller pods, with thin husk, Oval shape smaller seeds.
- b) Big Japan or Bombay bold type: The pods and seeds of this type are bigger than coromandal type.

Characteristics of main axis and laterals

Main and laterals	Erect	Bunch	Spreading	Semi-spreading	Trailing
Main axis	Short and erect	Long and erect	Very short and erect	Intermediate between bunch and spreading	Medium length and erect
Laterals	Erect, slightly oblique to main axis but almost parallel to it.	Oblique to main axis	Spread horizontally along the ground usually an inch above ground except the tips.	Prostrate up to a few internodes and then begin to ascend in a bow shaped pattern.	Trail along the ground they are flat on the ground up to the extreme tip.

The groundnut as such can be classified as erect or bunch, spreading, semi-spreading and trailing types.

Climatic requirement

Groundnut is a tropical plant requires a long and warm growing season. It grows well in areas receiving 50 to 125 cm of well-distributed rainfall during growing season, abundance of sunshine and relatively warm temperature. Soil temperature is an important factor and its effects are critical on seed germination, emergence of seedlings, early plant growth, rate of flowering, and pod development. When soil temperature goes below 19 °C, emergence of seedlings is low. The optimum temperature for vegetative growth of groundnut is ranging in between 26 to 30 °C depending on the cultivar. Reproduction growth is maximum at 24-27 °C. The maximum rate of growth of pods between 30 to 34 °C as it requires about a month of warm and dry weather. Light influences both photosynthesis and respiration in groundnut. The opening of flowers and number of flowers both depend on light.

In India, groundnut is generally sown in four seasons

Kharif: About 85 % of the total groundnut in India is sown in the kharif season under rainfed conditions.

Rabi: Groundnut is grown in rabi season on a limited area where winter is not severe and night temperature do not go below 15 °C. This crop is usually cultivated in rice fallow field and utilizes the residual moisture after harvest of rice or with minimal irrigation (5-9). Rabi groundnut is raised on coastal regions, river deltas of Krishna, Godavari and Kaveri and other irrigated areas in part of Tamil Nadu, Andhra Pradesh and Karnataka.

Summer: Summer cultivation of groundnut is mainly taken in the states of Tamil Nadu, Andhra Pradesh, Karnatakam Gujarat and Maharashtra states (9-12 irrigations).

Spring: Spring cultivation of groundnut is taken in the states of Uttar Pradesh, Punjab and West Bengal etc. (March to May).

Soil

Groundnut does well in the well drained, light textured, loose, friable and sandy and sandy loam soils which helps in easy penetration of pegs and their development and also harvesting. Clay or heavy soils are not suitable for this crop as they interfere in penetration of pegs and make harvesting quite difficult. Groundnut is sensitive to soil salinity. It gives good yields in the soil having the pH between 6.0 to 7.5, well supplies with calcium and a moderate amount of organic matter.

Field preparation

Although the groundnut is a deep rooted crop, but looking to its under ground pod forming habit, deep ploughing should be avoided, because it encourages development of pods in deeper layers of soil which makes harvesting difficult. Adequate rains at sowing are necessary for proper germination and good plant growth and well-distributed rainfall during the crop period ensures normal vegetative growth, increased flowering and proper

development of pods. One ploughing with soil turning plough followed by two harrowing would be sufficient to achieve a good surface tilth up to 12-18 cm depth.

Seeds and sowing

Bold and filled pods should be selected and shelled by using either hand or power operated decorticator just before sowing. From the shelled seeds, small, shriveled, damaged and broken seeds should be removed and only bold ones should be used for sowing.

Seed treatment

For control of seed borne diseases, treatment of groundnut seeds with Thiram (3 g/kg of seeds), Mancozeb (3 g/kg of seeds) or carbendazim (2 g/kg of seeds) is recommended. Thereafter, seeds should be inoculated with proper strain of Rhizobium culture particularly in those fields where groundnut is to be grown first time. Seed are treated with quinalphos 25 EC @ 25 ml or chlorpyrifos 20 EC @ 25 ml/kg of kernels for control of white grubs. To break the seed dormancy of spreading type varieties, give the seed treatment of etharel.

Some times rodents and crows are noticed to take away the seed from the field; therefore, use of repellent like Pinetar and Kerosene for seed treatment are recommended to keep the intruders away but the care should be taken to avoid any injury to the kernels.

Sowing

Usually groundnut sowing is undertaken with the onset of monsoon. But where irrigation facilities are available, pre-monsoon sowing should be done in the last week of May or in the first week of June with pre-sowing irrigation, which increased the yield by 46 % in Gujarat and in Punjab, shifting of sowing date from normal time of first week of July to 20th June increase the pod yield of about 19 %. Early sowing helps in best utilization of monsoon by the crop because germination of all seeds will take place before rains start and the field is also vacated in time for the sowing of the winter (rabi) crop. Rabi crop is sown from September to December depending upon vacate of the rice fields. The summer crop is sown in the last week of January (second fortnight of December to first week of February depending upon the temperature prevails in the regions) to first week of February. The spring crop is sown from the second fortnight of February to first week of March after harvest of toria and potato crops.

Sowing method

Seeds should be sown about 5 cm deep with the help of country seed drill or they are sown behind the country plough. Dibbling of seeds by keeping 60 cm distance in row to row and 10 cm distance in plant to plant for spreading type and 45 cm x 10 cm in bunch type helps in saving the seed requirement and also increased the yield as the sufficient space is provided around the plant for its better growth and development.

Groundnut is generally sown in flat beds with 30 cm x 10 cm spacing. In Saurashtra region of Gujarat, set furrow system of groundnut cultivation is still practice by the farmers.

In set furrow system, farmers use same furrows (90 cm) year after year for groundnut cultivation.

In cross method of sowing, total seed lot is divided in to two parts, first half of the seed lot is sown in one direction by adopting recommended row to row spacing and second half lot is used for perpendicular sowing just to first direction by adopting same row spacing. This method of sowing helps in maintaining optimum plant population and found advantageous where groundnut cultivation is succeeds by rice cultivation.

In paired row sowing method, two pairs of rows are spaced at 45-60 cm with a spacing of 22.5-30 cm within the pair. This method also gives about 20 % higher yield than line-sown crop.

Broad bed and furrow method is useful in high rainfall area having deep vertisol where drainage of excess water is a problem. In this method, stored moisture in the furrows are utilized effectively by the crop and gives about 15 % higher yield than flat bed method.

Spacing: Spreading varieties: 60 cm x 10 cm
Bunch type varieties: 45 cm x 10 cm

Farmers of south Saurashtra growing summer groundnut GG-2 are advised to sow the crop at 22.5 to 30 cm with a seed rate of 120 kg/ha. For spreading type groundnut GG-11 in kharif season, it should be sown at a spacing of 75 cm with the seed rate of 110 kg/ha.

Selection of seeds

Quality of seeds is of prime importance for establishing the optimum plant stand. Pods for seed purposes should be stored unshelled in a cool, dry and well-ventilated place. For seed purposes, pods should be shelled by hand 1 week before sowing time. Hand shelling insures little damage to seeds. Pods shelled long before sowing time are liable to suffer from loss of viability and storage damages. Discard shriveled, small and diseases kernels. Only bold seeds should be used for sowing to get good stand.

Seed rate

Seed rate is always depends on the spacing, type of seeds and germination percentage. Use of optimum seed rate is the key factor for maintaining recommended plant population

Spreading type varieties: 80-100 kg/ha according to the size of kernels (GAUG-10 requires 80 kg kernels/ha, GG-11 and M 13 requires 100 kg kernels/ha)

Bunch type varieties: 100-125 kg/ha according to the size of kernels (JL 24 requires 125 kg kernels/ha, J 11 and GG 2 requires 100 kg kernels/ha)

Manures and fertilizers

Manures: 25 CL well decomposed FYM or compost/ha

Fertilizers

N kg/ha	P ₂ O ₅ kg/ha	K ₂ O kg/ha	Stage of application
12.5	25	0	As basal application

The pod formation and development of groundnut is greatly influenced by fertilizer application. Lime application accusses better nodulation.

The entire quantity of phosphorus should be applied about 4-5 cm in the side of the seed and 4-5 cm below the seed level before sowing. N may be applied preferably in the form of ammonium sulphate as it contains sulphur, which is directly involved in biosynthesis of oil. Phosphorus fertilizer is very much important as it promotes root growth and development of rhizobium and helps the crop to tide over moisture stress. Single super phosphate is the best source of phosphorus as it contains 16 % phosphorus besides 19.5 % calcium and 12.5 % sulphur. Gypsum is the cheapest source of calcium (24 %) and sulphur (18.6 %). Well powdered Gypsum may be applied to the crop @ 500 kg/ha when it is in peak flowering stage on the soil surface as close to the base of the plant as possible because calcium is picked up by the peg and the developing pod. Calcium too has pronounced effect on proper development of pods and kernels. Groundnut being a legume and oilseed crop has greater requirement for sulphure and phosphorus. P is a constituent of enzymes, phospholipides and protein, while S is a constituent of S containing amino acids and helps in fatty acid synthesis. Calcium is another important mineral for groundnut production. Groundnut has unique characteristics of absorbing about 75 % of S and Ca through gynophores and developing pods.

Due to ever increasing cost of chemical fertilizers, greater emphasis has been given on the use alternate and renewable source of fertilizers. Rhizobium inoculation is found beneficial in the areas where groundnut is introduced first time. It has been reported that 15-30 % and 15-50 % yields can be increased in summer and kharif cultivation of groundnut by inoculating the seeds.

In south Gujarat, farmers growing GG-2, GG-13 and GG-10 under medium black calcareous clay soil during kharif season are advised to apply 12.5 kg P₂O₅/ha. instead of existing recommended dose of 25 Kg P₂O₅/ha.

Farmers of coastal region of south Saurashtra who are raising monsoon groundnut with saline water are advised to mulch the open space with wheat straw @ 5 t/ha for higher production (25 %). In shallow alluvial soils of coastal area of south Saurashtra, farmers

growing groundnut – wheat in a sequence with poor quality water EC up to 7 dS/m) are advised to apply Gypsum @ 75 % of GR (3.75 t/ha) before monsoon every year. In the south Saurashtra zone, use of FYM once in two years was also found beneficial.

Yellow leaf deficiency (Fe deficiency) is corrected by spraying of 1 % FeSO₄ + 0.01 % Citric acid (15 g FeSO₄ + 1.5 g Citric acid in 10 liters of water). Yellowing of veins (Zn deficiency) is corrected by spraying of 0.2 % ZnSO₄ or basal application of ZnSO₄ once in three years @ 50 kg/ha. Unfilled pods (boron deficiency) are corrected by 0.1 % borax.

Irrigation

Groundnut being a rainy season crop, it does not require irrigation unless the dry spell period prolonged and irrigation facilities are available. If dry spell occurs, irrigation may become necessary during critical stages. Flowering, peg formation and pod development stages are critical for irrigation in groundnut. Life saving irrigation during the critical stages of the crop growth results in an increase in pod yield to the extent of 63 % in Gujarat, shelling is increased by 5 %. However, lack of soil moisture at these stages was found to be most crucial factor holding up groundnut production. Hard soils are irrigated before harvest to facilitate easy harvest.

In Southern part of the country where rabi groundnut is taken, 3-4 irrigations are required. The first irrigation is given at start of flowering and subsequent irrigations are given during the fruiting period to encourage peg penetration and pod development. The first irrigation before harvesting will facilitate the full recovery of pods from the soil.

The farmers of middle Gujarat Agro-climatic zone growing summer groundnut are advised to irrigate the crop at physiological growth stages viz., branching (25-30 DAS), flowering (40-45 DAS), peg formation (55-60 DAS), peg penetration (65-70 DAS), pod formation (80-85 DAS), pod development (91-95 DAS), pod filling stage (102-107 DAS) and ripening (115-120 DAS) along with a common irrigation after sowing (nine irrigations each of 5 cm).

The farmers of south Saurashtra growing summer groundnut are advised to irrigate the crop at alternate day (43 irrigations) through sub surface drip irrigation method (with lateral at 60 cm distance in alternate row of groundnut and drippers of 4.0 lph at 45 cm distance of each laterals) 0.8 CPE i.e. operating the system with a pressure of 1.2 kg/cm² and combining fertigation with 100 % recommended dose (25-50-0 NPK kg/ha) and two hand weedings at 30 and 60 DAS for securing higher production and net return per hectare with 29 and 18.5 % of increase in pod yield and water saving, respectively and 4.63 kg/ha-mm of WUE as compared to surface irrigation method. In the same area, the farmers for giving protective irrigation to groundnut can use non-sodic saline ground water.

Aftercare operations

1) Weeding and interculturing

Weeds result in severe competition with the crop and cause a considerable reduction in yield to the extent of 25 to 50 % based on nature of weed infestation in the field. Weed problem is very severe in the initial stage due to slow growth of the crop. The critical period of weed competition was found to be from 28 to 42 days after sowing. The Crop should be kept absolutely weed free up to 60 days of sowing by following 2-3 interculturing operations followed by hand weeding but care should be taken that soil should not be disturbed at pegging and pod formation stage. The earthing up should also be taken up simultaneously with interculturing operations. Basic idea of earthing up is to promote easy penetration of pegs in soil as soil also to provide more area to spread. Where labour cost is high and timely non-availability of labour, chemical weed control through weedicide, fluchloralin @ 0.9 as pre-emergence should be applied besides carry out interculturing and hand weeding at 20, 45 and 60 days of sowing the crop. In shortage of labour, hand weeding should be carryout as at 25 and 45 days of sowing.

In south Saurashtra, hand weeding followed by interculturing should be carried out at 20 and 40 days of sowing for effective control of weeds in kharif groundnut. In shortage of labour, weedicide like fluchloralin @ 0.9 kg/ha or pendimethalin @ 1.0 kg/ha or Oxyfluorfen @ 0.18 kg/ha or Oxadiazon @ 1.0 kg/ha as pre-emergence should be applied or fluozifop- p- butyle @ 0.25 kg/ha at 20-25 days after sowing should be sprayed along with interculturing at 30 days of sowing.

In Saurashtra region, the crop should be kept weed free by carrying our hand weeding at 15, 30, 45 and 60 days of sowing.

2) Use of hormones

Seeing the growth behaviour of the crop, we find that groundnut usually suffers from 2 drawbacks, the first is that the crop being non-determinate keeps on flowering and production pegs simultaneously upto maturing and the second is that the pods start germinating once after reaching physiological maturity, if they get water. As a result more than 50 % of plants energy is lost in producing non-effective pods and effective pods germinate, if there is rain or irrigation. These both the conditions lead to very poor yield and quality of the produce.

Application of MH (Maleic hydrazide) near maturity results in inducing dormancy in the pods for about 20-30 days which checks the germination of matured pods even if they get water. Thus it helps in easy harvesting of the crop. If the soil has dried the field may be irrigated and the crop can be harvested by the help of plough harrow or cultivator. Application of growth hormone like planofix or Vardhak at the time of flowering have been found to reduce excessive vegetative growth and flowering period which ultimately

increases the number of effective pods/plant, test weight and the yield/unit area. The most ideal time for hormonal application in groundnut is 40 to 80 days after sowing and the best concentration is 20 ppm.

The crop should be sprayed with growth stimulant MS-III N 0.1 % (40 DAS) or Boric acid 0.2 % (30 DAS) for maximum yield and highest net return under middle Gujarat conditions.

Plant protection measures

Insects

The major pests causing yield losses in groundnut are aphids, jassid, thrips, whiteflies, leaf miner, white grub, army worm and heliothis etc.

The major sucking pests like aphids, jassids, thrips and white flies can effectively control by spraying of Phosphamidon 0.03 % or Dimethoate 0.03 % or Methyl-O-Demeton 0.025 % at an interval of 10 days.

Light trap attracts moths of leaf miner, which are collected and then destroyed. These pests also controlled by spraying of Dichlorvos 0.05 % or Monocrotophos 0.04 % or Quinalphos 0.05 % or Endosulphan 0.07 % or Carbaryl 0.2 % dust at an interval of 15 days.

Spodoptera and heliothis are nocturnal in habit and hence control measures should be taken up either in early morning hours or late evening hours or preferably during nights. To control these pests, spray chlorpyrifos 0.05 % or Endosulphan 0.07 % or Monocrotophos 0.05 % or quinalphos 0.05 %. These pesticides are effectively controlled initial larvae stage.

In areas where white grub problem is very severe, the soil may be drilled with Phorate 10 % granules @ 25 to 30 kg/ha in the furrows about 10 cm deep before sowing.

Diseases

The important diseases occurring on groundnut are Tikka, stem rot, rust, leaf spots etc. Tikka and rust can be controlled by spraying Carbendazim 0.05 % + Mancozeb 0.2 % (0.5 g/l + 2 g/l, respectively) at 2-3 week interval, 2 to 3 times, starting from 4-5 weeks after sowing. Bud necrosis is caused by a virus but no control measure is suggested, however, thrips are responsible for transmitting the virus should be controlled by spraying systemic insecticides.

Inter cropping

Area under kharif groundnut is not likely to expand any further in India. The most potent way of increasing the area is by finding a place for groundnut as an inter crop. Two systems give some safety to the farmers against the natural calamities and helps in better utilization of farm resources. As a result of research effort, stable and remunerative inter-cropping systems with cereals, pulses and other oilseeds have been identified for dry land areas. The most promising inter cropping of groundnut identified in recent years are inter

cropping of groundnut and pigeon pea followed by inter cropping of groundnut with sunflower and groundnut with cereals.

	Intercropping		mixedcropping
1	It is practice of growing two or more crops on the same piece of land at a time with definite row proportion	1	It is practice of growing two or more crops on the same piece of land at a time but, without any row proportion
2	Each crop is provided separate row in different proportion	2	All crops are grown in one row by mixing the seeds before sowing
3	Main objective is to increase the production per unit area per unit time		Main objective is to provide insurance against complete crop failure due to vagaries of nature

In Gujarat following inter cropping systems are possible.

- Groundnut + Castor (3:1 ratio)
- Groundnut + Pigeon pea (3:1 ratio)
- Groundnut + sunflower (3:1 ratio)
- Groundnut + Sesamum (6:1 ratio)

Other crop rotations are

- Maize (summer)- groundnut- gram or sarson
- Groundnut – onion or garlic
- Green gram - Groundnut – wheat
- Maize - groundnut – pea
- Lobia - groundnut –wheat

Groundnut crop grown in rotation with wheat, gram, pea, barley etc. It is grown in mixed with maize, pearl millet, castor, sorghum and cotton. Groundnut can also be followed by safflower where early varieties are used and moisture remains in the soil at the time of harvest.

Harvesting

The prominent symptoms of maturity are yellowing of foliage, spotting of leaves and dropping of old leaves. The pod is mature when it becomes hard and tough and when there is dark tint on the inner side of the cells. Harvesting before maturity lowers the yield due to shrinkage of seeds when they dried.. Delaying in harvesting germinate the seeds in the field it self due to dormancy in bunch type of varieties. In spreading varieties, more pods remains in soil due to broken of roots, which reduce yield and increase labour cost for picking up the pods from the soil.

In case of bunch type of groundnut, the plants are harvested by pulling. Harvesting of spreading type of groundnut is done by local plough or with the help of blade harrow. Leave the harvested crop in small heaps for two to three days for curing and drying. After drying, collect the crop at one place and detach the pods either by hand or by using pucker

or thresher for separating the pods from the plants. The dried fodder, which is also known as haulm, is used in cattle feed.

Drying and storage of pods

The pods for storage must contain moisture less than 9 % and kernels 8 % as the higher moisture level in the produce are congenial for the production of aflatoxin caused for liver cancer of our body.

Yield

1500 to 2000 kg/ha (spreading type), 1000 to 1500 kg/ha (bunch type). Ratio of the kernels to pods is 70:30 (kernels and shell).

Varieties

Important characteristics of the improved groundnut varieties under cultivation in Gujarat State are given below in Table.

Variety	Year	Release from	Area for cultivation	Shelling %	Oil %	Maturity days	Yield (q/ha)
GAUG-10	1973	JND (S)	Entire state	70	50	110-120	20-25
GG-11	1984	JND (S)	''	74.6	50.2	100-105	14
GG-12		JND (S)	''	71.2	49.6	110-115	15
GG-13		JND (S)	''	69.2	49.6	120	15
GG-20	1997	JND (SS)	''	73.4	50.7	109	20
J-11	1965	JND (B)	''	73.2	49.2	95-100	26
GG-2	1983	''	''	70.5	49	100-105	31
JL-24	1978	Jalgaon (B)	''	72	50	90-95	18-23
GG-4	1994	JND (B)					20
GG-5	1998	''	''	73.7	48.8	101	13
GG-6	2001	JND (B)	''				28

NB: S= Spreading, SS= Semi spreading, B= Bunch or erect

S U M M E R G R O U N D N U T

Now a day, summer groundnut cultivation is successfully done due to varieties released for summer season. It is confined to six States in the country viz., Andhra Pradesh, Tamil Nadu, Gujarat, Maharashtra, Karnataka and Orissa.

The area under irrigated summer groundnut accounts for about 16 % of the total area and contributes to about 28 % of the total production. The yield level of summer groundnut is almost double than those of kharif groundnut. The average productivity of summer groundnut in the Gujarat is around 1700 kg/ha as against 950 kg/ha in kharif season. Summer cultivation in Gujarat is about in 1.0 lakh hectare with the production of

1.62 lakh tones dried pods. Since the irrigated crop is not subjected to vagaries of monsoon rains and is less exposed to pest and disease complexes, there is an immense possibility of increasing productivity and stabilizing production of groundnut. Weeds infestation is also less in summer season as compared to kharif and they are easily controlled, as the rain is not interfering in the intercultural operations. Besides these, the crop is highly responsive to irrigation and gives maximum water use efficiency.

Time of sowing

Third week of January to first week of February is most suitable period for sowing of summer groundnut. Early sowing affects the germination due to low temperature results in lower yield and delay in sowing damaged the pods as it is matured at the time of onset of monsoon. The time of sowing for summer groundnut is depend upon the soil and atmospheric temperature. The minimum temperature in the top layer of soil should not be less than 18 °C. If it is goes below 18 °C, emergence of groundnut seedlings is slowed down resulting in poor plant stand and ultimately gives lower yield.

Soil

The crop does well in the well-drained, sandy loam soils. Groundnut is sensitive to soil salinity.

Varieties

Generally erect or bunch groundnut is preferable for summer cultivation. Varieties like J-11, GG-2, GG-4, GG-5, GG-6, GG-20, GAUG-1, are recommended for summer cultivation. JL- 24 is sensitive to heat resulting in poor yield.

Life period

Summer groundnut varieties require 110-120 days for maturity, which matures within 90-100 days in kharif season. The reason for delay in maturity during summer season is due to the fact that in summer it requires 10 to 15 days for its germination as compared to 4-5 days for germination in kharif season.

Choice of improved varieties

Bunch type groundnut varieties are grown in summer as they mature earlier and harvested safely before onset of the monsoon. The bunch type varieties like GG-2, GG-4, GG-5, GG-6 are bunch type varieties and GG-20 is semi erect type variety are generally used for summer cultivation.

Seed rate

100 kg/ha healthy kernels should be used for sowing for getting appropriate plant population because plant population is one of the limiting factors for groundnut production. Variety JL 24 requires 125 kg kernels/ha because of its bold size. Seed rate is depends upon the size of the kernels. The farmers are using less seed rate because of its high cost.

Seed treatment

As per kharif season crop (except for control of white grub as infestation of white grub is not a serious problem in summer season..

Spacing

The spacing should be 22.5 to 30.0 cm between the rows and 10 cm between the plants. Cross sowing can also be used but there was no any remarkable difference in yield was observed in cross and line sowing crop of groundnut.

Fertilizers requirement

N kg/ha	P ₂ O ₅ kg/ha	K ₂ O kg/ha	Stage of application
25	50	0	As basal

Well powdered Gypsum @ 300 kg/ha should be applied at the time of peg formation (when it is in peak flowering stage (40 DAS) on the soil surface as close to the base of the plants as possible) as it contains 24 % calcium and 18.6 % sulphur, which help in oil synthesis.

Weed control

Two hand weeding or interculturing twice or thrice between the rows till the crop permit (up to flowering only) should be carried out for controlling the weeds. In scarcity and unavailability of labour, pendimethalin @ 1.0 kg/ha or fluchloralin @ 1.5 kg/ha as pre-emergence application is found effective for controlling the weeds.

In summer groundnut, Oxyfluorfen @ 0.24 kg/ha as pre-emergence followed by one hand weeding and interculturing at 45 days of sowing should be carried out for controlling the weeds. If it is not possible to spray the above weedicide after sowing the crop, same should be applied at the same rate as pre-planting.

In south Sairashtra, for effective control of weeds in summer groundnut, two hand weeding and interculturing at 20 and 40 days of sowing should be carried out. For chemical weed control, fluchloralin or pendimethalin @ 1.0 kg/ha as pre-emergence along with one hand weeding and two interculturing should be carried out.

Irrigation

Generally 8-9 irrigations are required for the crop season. After the crop is established, it is necessary to withheld the irrigation for about 25 days and create stress which will encourage early flush of heavy flowering, root development, nodulation and checks excessive vegetative growth.

The first irrigation should be given immediately after sowing the crop. The second irrigation is given when the flowering is observed in 50 % plants. During pegging and pod filling, the irrigation should be given at an interval of 8-10 or 10-12 days. Fifty to eighty

(50 - 80) days after sowing are most critical period and during this period there should not be a water shortage because peg penetration, pod formation take place during this period.

Groundnut crop can be irrigated by following methods.

1. Border strip method: The strips should be of 3-5 m width and water from the main channel is diverted into border strips. This is the one of the most suitable surface method and labour cost for forming bunds is less than check basin method.
2. Check basin: When field is undulated, this method is followed. Water is diverted into the sub channels and finally into the field.
3. Furrow method: This method is the most effective with maximum water use efficiency of 3.71 kg/ha-mm and also saves about 2-3 irrigations as compared to border strip and check basin irrigation methods.
4. Sprinkler and drip irrigation methods: Use of sprinkler and drip irrigation methods are becoming popular since water requirement in these methods is about half than the conventional methods and the water use efficiency is also quite high but the only draw back is the high initial cost involved. A yield advantage of 30-32 % over the check basin method can be achieved with the sprinkler irrigation method.
5. In south Gujarat heavy rainfall areas, use of mini sprinkler for irrigation to summer groundnut gives about 22 % more yield and 38 % water saving as compared to surface irrigation method. The first irrigation should be given immediately after sowing, subsequent two irrigation at 8 to 10 days interval and five irrigations at 12-13 days interval with 50 mm depth of irrigation. The sprinkler set should be laid out at 2.5 x 2.5 m spacing, 1.8 kg/cm² pressure, 6.5 hours operational).
6. In middle Gujarat, summer crop should be irrigated through sprinkler to get about 18-20 % more yield and income with about 10 % saving in irrigation water. Under sufficient water available, the system should be operated at 10-12 days interval in the months of February – March and 8-10 days interval in April and May months. Under conditions of water scarcity, the system should be operated in three weeks interval during February and March and two weeks' interval during April and May. The set should be operated for about three hours for 22 % water saving and bring about additional 0.40 ha land under irrigation. The sprinkler should be laid at 12 x 12 m spacing and should be operated at 2.75 kg/cm² pressure to achieve 1.67cm/hr application rate for total application of 50 mm depth.

Harvesting

The bunch variety matures in about 110-120 days. Harvesting before maturity lowers the yield. Hard soils are irrigated before harvest to facilitate easy uprooting of the plants. Generally in bunch variety, harvesting is done by hand pulling of the whole plants a day after light irrigation. The fresh and matured pods are picked up manually in the field itself and dried in the threshing yard depending upon the weather conditions otherwise the plants are allowed to dry it along with the pods in the field and then carted at the threshing yard and pods are separated with the help of thresher. The pods are allowed for drying in

the threshing yard till they contain 9 % moisture for good storage. The dry haulm (fodder) is used as cattle feed.

Plant protection measures

Pests: Leaf miner, thrips, jassid and heliothis.

Research Station

- ICRI SAT (International Crop Research Institute for Semi-Arid Tropics), Patancheru, Hyderabad (AP).
- NRCG (National Research Center for Groundnut), ICAR, Junagadh, Gujarat Main
- Oilseeds Research Station, Junagadh, Gujarat.