CHAPTER 1

INTRODUCTION
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Groundnut is an important cash crop. The nuts are highly nutritious for high oil and protein contents. For high oil content of the seeds groundnut has occupied a special position among crops. It contributes about one-sixth of the world's supply of vegetable oils. This vegetable oil is extensively used for cooking purposes and also for the manufacture of hydrogenated vanaspati, soap and toilet requisites. Groundnut yields 549 Kcal/100 gm which is nearly 5 times that of beef. Kernels are also eaten raw, roasted or sweetened. Peanut butter is a very nutritious food. The groundnut protein is used in the manufacture of a synthetic fibre called 'ardil'. The crop is also of value as a rotation crop. Being a legume with root nodules, it can enrich the soil with nitrogen and thereby improves soil fertility.

The seeds of groundnut have protein (25-28%) and oil (43-55%). The kernels are also rich sources of phosphorus and vitamins particularly thiamine, riboflavin and niacin. The principal fatty acids are oleic acid (56%), linoleic acid (25%), palmitic acid (6-12%) and a little each of stearic, arachidic and higher saturated acid. Arachin and conarachin are two important proteins found in the seed.

It is well known fact that human beings derive their energy from the three major nutrients - proteins, fats and carbohydrates. The diets of people from most countries provide an average of 10 per cent calories from proteins; the non-protein energy amounting to about 90 per cent of the total comes from fats and carbohydrates. Carbohydrate-yielding cereals form the most important food group; fats come a close second, as they are a concentrated reserve of energy. Fats have the highest available energy density -9 Kcal/g as compared to 4 Kcal/g proteins and carbohydrates (Kak 1995).
1.1 Distribution

A native of Brazil, it has been widely distributed throughout the world. The plant is now extensively cultivated in tropical and sub-tropical regions lying between $35^0\ S$ and $40^0\ N$, but extends to $45^0\ N$ in Central Asia and North America where there is hot summers and up to an altitude of 3,500 feet above sea level. The most important groundnut growing countries are India, China, USA, Sudan, Senegal, Nigeria, South Africa, Indonesia, Brazil, Burma, Argentina and Thailand.

In India groundnuts are cultivated extensively in Gujarat, Maharashtra, Andhra Pradesh, Tamil Nadu, Karnataka and Madhya Pradesh. These six states contribute about 93 per cent of the total Indian acreage. Of late, Uttar Pradesh, Rajasthan, Punjab, Orissa and Kerala have also started growing this crop on a fairly large scale whereas Bengal, Bihar and Assam are still lagging behind in the production of groundnut.

1.2 General description

Groundnut, the botanical name *Arachis hypogaea* L. is a member of Papilionaceae, the largest and most important of the three divisions of Leguminosae. The crop plant is popularly known as Peanut, Monkey nut, Earthnut, Goobernut. In India groundnut is known by different names such as China badam, Badam, Mugphali, Mungphali, Manila kottai, Kappalandi, Bhuimug, Nela-gadale, Bucha-naka, Nelakadalai and Nelasenagalu.

Groundnut is an annual legume crop and in general the two main types grown commercially are distinct in appearance. Bunch type is upright with an erect central stem and vertical branches, whereas the runner type is recumbent with numerous creeping laterals.

*Rhizobium* is responsible for symbiotic association producing root nodules. Many strains with physiologically different characteristics have been isolated but all
these appear to be equally symbiotically effective (Singh et al. 1976).

The stem is usually circular in section, covered with fine hairs, composed of short internodes sometimes tinged with red and may become hollow with age (Yarbrough 1957).

Leaves are stipulate, alternate, pinnate with three or four leaflets carried on long petioles. The leaflets are obovate, softly hairy, 3-5 cm long and show characteristics daily sleep movements.

The small, some 12mm long, flowers are carried on axillary branches singly or in small groups and are produced near the base of the stem and branches. A proportion may be produced underground. Ordinarily groundnut flowers are self-pollinated (Culp et al. 1968), but cross pollination may take place due to the visitation of the flowers by (insects) bees (OFC 1954, Gibbons and Tattersfield 1969, Leuck and Hammons 1965).

After 7-10 days of fertilization, the receptacle thickens, elongates, turns downward and forces the ovary into the ground (pegging).

The fruit with longitudinal and transverse ridges is oblong, more or less constricted pod of pale straw colour. The shell of pod which contains the seeds is morphologically the pericarp. Pods are tightly attached to pegs.

Pods contain one to several ovoid seeds, each enclosed in a papery seed coat or testa. Testa colour varies from creamy white or yellow through to dark red almost purple. Each seed consists of two elongated, cream coloured cotyledons with a short radicle and plumule.

The optimum temperature for groundnut cultivation lies between $24^\circ$C to $30^\circ$C. As regards the minimum temperature about $16^\circ$C appears necessary for this crop
and any diminution in warmth even to a slight degree causes serious injuries. Groundnut can be grown successfully in areas having a rainfall as low as 20 inches and as high as 50 inches. The plant can bear neither frost, nor long and severe drought or water stagnation (Verma 1985). The ideal rainfall conditions for this crop would be about 7.8 to 12.5 cm during the summer months preceding the cropping season for aiding preparatory cultivation of the land, about 12.5 to 18 cm of rain during the fortnight of sowing and about 38 to 64 cm of well-distributed rainfall during the crop growth for about 3 to 4 months followed by sunny weather at harvest time (John 1948).

Light coloured, loose, friable, well-drained, sandy loam, rich in calcium and a moderate amount of organic matter is suitable for groundnut cultivation (John 1948).

The optimum soil pH for groundnut is 6.5, but this crop can stand pH fluctuation between 4.5 and 8.5 (Wamanan 1965).

Groundnut is raised mostly as a rainfed kharif crop, being sown from April-May to June-July depending upon the receipt of monsoon rains. An irrigated crop is grown to a limited extent in South India between January-March and May-July. In Assam the favourable month for sowing of groundnut is September-October (Wamanan 1965).

Dormancy in various kinds of seeds can persist for a period of days to millenia either due to the presence of certain inhibitors or some built in defects in seeds and parts thereof (Mayer and Shain 1974, Taylorson and Hendricks 1977). Several instances of the presence of inhibitors in seeds responsible for their dormancy have been reported (Sreeranulu and Rao 1971a). Dormancy can be overcome by treating the seeds with growth regulators (Sharma et al. 1976, Yamaguchi et al. 1983).
Germination of plant seed involves a complex series of metabolic processes such as water imbibition, respiration, nucleic acid and protein synthesis, mobilization of food reserves as well as cell differentiation and growth. Plant fatty acid synthesis has been studied with peas by Macey and Stumpf (1968).

1.3 Plant growth regulators on germination, growth and yield

Two or more hormones can be similar or dissimilar in their action. The action is cumulative when their total effect is the sum of their individual effects. When the action of two hormones are opposite to each other, it is termed as antagonistic. The growth and development of the plant body is the sum total of the interactions of different hormones that may be present in the plant.

*Gibberellins* have been shown to play an important role in the germination of cereals like barley, wheat etc. It brings about germination in a wide variety of seeds showing various forms of dormancy (Lang 1965). The isolation of gibberellin-like compounds from *Phaseolus*, lettuce and many other seeds further strengthens the importance of gibberellic acid on germination in nature.

Gibberellic acid (GA$_3$) the most active form of gibberellins has long been known for its stimulatory effect on seed germination. Gibberellins cause germination of many light requiring seeds in darkness thereby substituting the effect of red light as reported by Kahn *et al.* (1957) and Kahn (1960). Khan *et al.* (1965, 1967) showed that gibberellic acid is a potent germination stimulator of *Lactuca scariola* and *Lactuca sativa* in the dark. Stimulation of germination by gibberellic acid has been found in a variety of seeds inducing those with a chilling requirement, a light requirement or a need for after-ripening in dry storage (Wareing and Saundars 1971).

Stimulation of germination of photoblastic seeds of lettuce and tobacco in dark was also reported by Sarma and Chakraborty (1975, 1977), Sarma and Barooah
GA₃ also stimulated the germination and seedling growth of *Raphanus sativus* (Sarma 1987). GA₃ at 200 ppm raised the germination rate and improved seedling growth in *Cichorium intybus* L. (Srivastava et al. 1974). GA₃ also enhanced germination in plants like groundnut (Sengupta et al. 1977).

The most spectacular effect of gibberellins is the transformation of dwarf plant into tall ones by greatly increasing stem elongation (Brian and Hemming 1955, Phinney 1956). Many dwarf species have been shown to respond to gibberellin treatment by marked stem elongation (Phinney and West 1960). Harada and Vergara (1972) showed that GA application increased the height of the plant, length of the internodes and leaf blades, leaf sheaths, but decreased tiller number in two dwarf varieties of rice.

Alder et al. (1959) have reported increase in corn plant height, when plants were treated with GA at certain developmental stage. Cherry et al. (1960) while finding increases in plant height in GA treated corn hybrids, observed decrease in leaf area. GA₃ treatment caused a sixfold increase in the height of the dwarf pea seedlings, compared to the control seedlings (Moore 1958). There are reports that photosynthetic activity of the plants treated with GA increases resulting in increase in dry matter content (Haber and Tolbert 1957, Zhukova 1965).

*Growth retardants* include diverse groups of chemicals with a common physiological effect of reducing stem growth by inhibiting cell division of the subapical meristem and exhibit dwarfing. The dwarfing compounds CCC, B-995 and Phosfon-D are reported to prevent the synthesis of gibberellin on the whole plant (Baldev et al. 1965, Dennis et al. 1965, Harada and Lang 1965, Ryugo and Sachs 1969). On the other hand, some workers claimed to have increased the level of endogenous gibberellins after treatment with growth retardants (Halevy and Shilo 1970, Reid and Crozier 1970 a,b, 1972).
Application of GA₃ is known to reverse the growth retarding effect of such compounds (Williams and Stahly 1970, Dunberg and Eliasson 1972). On the other hand, CCC at lower concentrations increased germination but higher concentration (above 2000 ppm) inhibited germination and seedling growth (Chinoy et al. 1968). CCC inhibited germination of photoblastic seeds of tobacco (Sarma and Chakraborty 1981) and lettuce (Sarma and Chakraborty 1976, Sarma and Barooah 1975-1976).

The objective of the present investigation was to examine the effects of GA₃ and growth retardants singly and in combinations on

(a) Germination of seeds,
(b) Vegetative growth in terms of length of shoots, number of branches and number of leaves,
(c) Chlorophyll contents of the leaves,
(d) Fat, sugar and protein contents of the seeds,
(e) Number of pods/plant,
(f) Weight of pods/plant and
(g) Yield/hectare.

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