Cotton has a taproot grows quickly and it can reach a depth of 20-25cm before the seedling has even emerged above ground. After emergence and unfolding of cotyledons lateral roots begin to develop: they first grow side ways and then down wards. The taproot continues to grow rapidly.

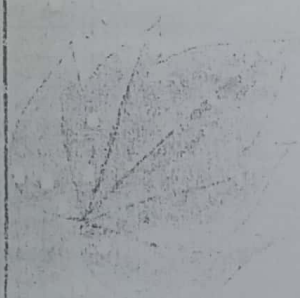
Final depth of root system depends on soil moisture, aeration, temperature and variety but is usually about 180-200 cm.

- Under dry growing conditions, cotton roots have been known to reach a depth of 3-4m.
- When soil moisture is adequate, most of the lateral roots are concentrated in the upper soil layer to a depth of 30-35 cm and may extend laterally to 100 cm and more. Under dry growing conditions lateral roots penetrate much more deeply.
- Factors affecting vegetative growth also influenced root growth of cotton plant.
- The growth of tap root as well as lateral roots are affected by excessive, moisture, hard dry soil layer and degree of soil alkalinity. Lateral roots adjust their quantum to the plant spacing and soil moisture regimes.
- Under conditions of water saturation and submersion, the laterals get asphyxiated and die but are regenerated when the optimum conditions reappear.

STEM

- Cotton plant consists of an ereet main stem and a number of lateral branches. The stem has a growing point at its apex, with an apical bud. As long as this bud remains active, lateral buds situated below the apical bud, remains dormant. The main stem carries branches and leaves but no flowers.
- Length and number of internodes determine the final height of the plant. As a rule plant with short internodes are early maturing.
- Length of internodes is determined mainly by the moisture supply while the number of internodes is usually a function of nitrogen supply to the plant.
- At the axil of each leaf are two buds, the axillary bud from which most vegetative and fruiting branches develop and a lateral bud on one side of axillary bud normally remains dormant: but if the axillary aborts, the lateral and may develop into a branch.
- Vegetative branches are morphologically similar to the main stem. They do not bear flowers or fruits directly, but carry secondary branches (fruiting branches), that are characterized by their sympodial growth habit.
- The fall in the growth rates noticed in the later half of the season is attributed to the deflection of carbohydrates from apex of the plant and the lateral apices of branches, to the developing bolls

LEAF



- Cordate, petiolate, three to nine lobed and palmately veined
- Size, texture, shape and hairiness vary a great deal
- Glands occur on leaves, bracts, petioles, stems and cotyledons.
- Nectaries are present on leaf calyx and bracts.
- Each leaf has two buds at its axis.
- Leaves are generally hairy, some varieties may have glabrous leaves. Hairy leaves cause fewer difficulties in mechanical harvesting but more tolerant to Jassids, but bear larger proportions of white fly which apparently find more sheltered conditions among the leaf hairs.

Branches:

- Lateral branches arise from the axils of the leaves of main stem
- Lateral branches consists of two types viz., Vegetative and fruiting
- Vegetative branches are more vertical and ascending
- Fruiting branches are nearly horizontal
- Fruiting branches the internodes are not straight as in main stem but have a zig zag appearance with the leaves alternately placed.
- Economic importance of sympodial branching is great. The flowering and fruiting are dependent on the initiation of

such branches and the timing or the crop for harvest is determined by the early or late production of such sympodial on the plant body. Very early varieties have their fruiting branches even at first or second node to the total exclusion of vegetative branching from leaf axils, similarly very late varieties grow producing a very large number of monopodial before sympodial divergence appear. In such cases, the late sympodial on the main stem and the secondary sympodial arising on the monopodial will contribute to the harvests.

- As a rule, the vegetative branches are located near the base of the plant and above these are fruiting branches. In most upland variables, the first fruiting branch generally develops on the 5th to 7th node whereas in 'Egyptian varieties' it is located on 8th or 9th node. In dense stands, the first fruiting branch generally develops at a higher level than in more open stands.
- Relative proportion of vegetative and fruiting branches is dependent on temperature, day-length, plant density and the rate of boll shedding.

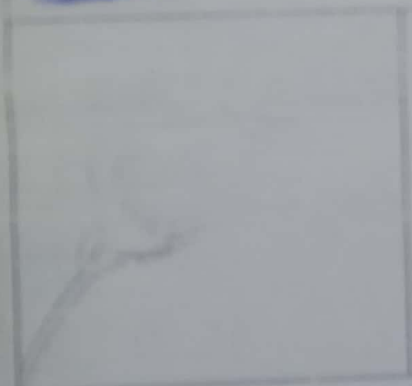
Floral Bud

- Floral bud is enclosed in and protected by three triangular bracts. The whole structure is called a "SQUARE" within the bud are the five petals of the corolla, wrapped tightly around one another. Within the corolla is a tube formed of numerous stamen filaments, surrounding the pistil.

- The ovary at the base of the pistil consists of from 3-5 fused carpels, containing as many locules or "Locks"
- Each lock contains from 7 to 9 ovules.

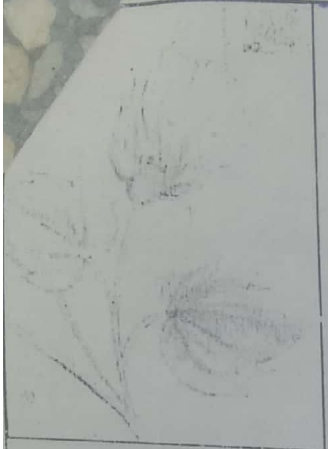
The ovary develops into 3-5 located capsules boll. From 7 to 9 seeds are set within each lock or locule

Flower



- Flower is large, showy, scented and white
- On account of the sympodial development of fruiting branches the flowers opening follows a apical course, in a basipetal and centrifugal succession.
- The outermost bud of the lowest and oldest branch is the first to open while the outermost bud of the highest and youngest branch is the last to do so.
- When the flower opens it is white or creamy white in the American Varieties, changes to pink towards the end of the day and becoming red the following morning, on the third day the petals wither and fall.

Fertilization:- 5-30% crossing pollination



- Self-pollination is the general rule in cotton.
- Pollen grains are relatively heavy and therefore wind is not a factor in the pollination of cotton.
- Cross-pollination in cotton may vary from ~~zero to 20~~ 5-30% percent.
- Cross pollination found to be greater in G.barbadense than G.hirsutum.
- Cross pollination is greater under dry-land conditions than under irrigation.
- Cross pollination is more in early flowers than in later-appearing flowers.
- Many insects are attracted to the cotton flowers, and they are active in cross-pollination.

- Some of the ovules may fail to develop normally, the aborted seeds are called "motes". Bolls in which the majority of ovules fail to develop are usually shed within ten days after flowering.

Fruit :-

- Bolls of Hirsutum are large (5-8g), pale green, smooth - skinned and with few oil glands. By contrast bolls of arboreum are much smaller (3g) dark green, covered with numerous glands
- Cotton plants by its remarkable auto-regulatory mechanism sheds the bolls that are in excess of the load capacity of the plant under given environmental conditions. As a result, the ratio of bolls to total vegetative growth is fairly constant. Cut off
- In general, varieties or strains with large bolls do not adjust so well to change in environment and to stress as do types with smaller bolls. Hence, shedding will occur more readily and to a large extent in the former than in the latter case.
- The development of fruit (boll) begins with the fertilization, and shedding of withered floral organs enclosing it.
- Bolls developing under falling temperature will lead more days to mature than those growing under rising temperature. The big - bolled American types in India take about 55 days while the Asiatic cottons require only 45 days which may further reduced to 35 days under higher soil and atmospheric temperatures. It may however, be stated that the first half period of maturation of a boll is spent in growth and the second half in internal development without any changes in the boll size.
- The boll consists of ~~four to~~ 3 to 6 six locules each of which contains number of seeds. Majority of Asiatic cottons have only upto 7 seeds per locules. A fair percentage of the seeds remain undeveloped due to non-fertilization, heredity and environment. These are called "motes".
- The size and shape of the bolls differ and are varietal characteristics.

Seed

- The full-grown seed is irregularly pear - shaped, varying in size depending on the variety and conditions of growing.
- It may be naked or bear short hairs called "fuzz". All cultivated cottons bear long fibres named "lint" and a majority of them have also fuzz on the same seed. The lint is removed by gins while the fuzz remains attached.

- The colour of fibres may be white, brown or green and that of the seed is usually gray, brownish or black.
- The mature seed has two cotyledons folded up and occupying the entire portion of its cavity. They are broad and kidney - shaped. Delayed germination in some of the species and varieties may be due to hard seed coat, closed micropyle and partially filled cotyledonary - cum - embryonic contents. The first two retarded the passage of water required for germination while the ill - developed contents were unable to swell rapidly and exert the requisite pressure for the early rupture of the hard coat necessary for the proper emergence of the plumule. The germination increased when the seed coat thickness was reduced by treatment with sulphuric acid or by abrasives or by partial removal at ends.

Cut off : An auto-regulatory mechanism in which cotton plant sheds the bolls that are in excess of its load capacity under given environment.

The seed account for about 65 to 70 per cent of the total yield by weight.
The kernels are rich in protein (10-20%) and oil (upto 25%). Egyptian cottons usually have a higher oil content than hirsutum cottons.

Seed Hairs :-

- Lint and fuzz represent the outgrowths of epidermal cells on seeds. Some cells continue to lengthen while others stop growing after a time. The former are the lint and the latter the fuzz.
- The lint hair is unicellular and its development is phased in two stages, the first is a period of elongation and the second in thickness. A lint cell bulges first, the proteplasm inside turns granular, and the nucleus moves towards the bulge. The swelling enlarges until it is twice the diameter of the original cell and the nucleus moves to or near the tip. The elongation of cell may take about 24 days, thereafter ceases. There is no change in thickness. The growth is not regular; slow at first but fast from about the 15th day. The rate slackens during days and quickens during nights.
- The cell wall thickens in the second half of boll maturation. Deposits of cellulose are formed on the inside of primary wall. They are laid in layers as seen from some fibres showing as many as 25 concentric layers.
- As soon as the boll dehisces, the hairs dry, collapse and flatten the cylindrical from, assuming ribbon like shape and go into spirals. The mature hair is uniform in diameter upto 3/4th length and then gradually tapers to a point.
- Lint at maturity contains three types ripe, half ripe and unripe fibres known as dead fibres, have thin walls, lack twist and are weak, with a tendency to break up during manufacture.
- The length of lint is a varietal character and varies from 5-50mm.
- The fuzz may either cover the entire seed coat as in hirsutums or be concentrated in a single tuft at the hilum end of the seed as in barbadense.

Glands :-

- On all aerial parts of cotton plants are found internal glands which in different species vary in size, number, distribution and pigmentation.
- These glands secrete a volatile oil (gossypol) and related compounds. Gossypol is a poly phenolic yellow pigment and is toxic to non-ruminants.
- The presence of gossypol made cotton seed cake toxic and hence, glandless varieties have been bred in recent years. However, it has been formed that glandless varieties are susceptible to a wide range of pests over the glanded varieties.

Growth and development (Stages of crop growth)

- The time required for emergence depends on soil temperature. In India cotton sown in June - July takes 5 - 6 days for emergence.

Emergence to flowering

- The first cotton leaf appears 10 - 12 days after emergence. Leaf development reaches its peak about three weeks after the first buds are formed.
- The first flower - bud appears on the lowest fruiting branch 35 - 45 days after emergence, depending upon prevailing temperatures. The other flower buds follow at regular intervals

until shortly before flowering ceases. The time taken between the appearance of first flower bud and opening of the flower may be between 25 - 30 days.

- Emergence of large number of flowers is seen for certain period and there after it declines. During the peak period of flowering the vegetative growth is almost negligible and once the rate of flowering declines the vegetative growth restarts.
- Period of flowering reduced by late sowing, strong plant competition and moisture stress.
- Strong positive correlation was observed between number of flowers produced and flowering period, hence the similar relation was noted between flowering period and yield.
- Environment and cultural practices have little influence on the time of flowering but the number of flowers can be increased by the factors favourable for growth.

- Fertilization takes place usually in the morning for few hours immediat after flower opening. After fertilization the flower drops at and a small left over called "square". Initially the boll development is slow and later growth rate is rapid and steady. About 3 weeks lapsed for the developm of boll to full size and for maturation of fibres and seed it may take abou weeks. Maximum weight of the boll normally altering in 45 - 50 days a fertilization followed by bursting of boll. The boll bursting depends temperature and varietal character.

Fibres which formed during the first two or three days developed into lint and subsequently formed fibres are of short nature comes under the name Fuzz.