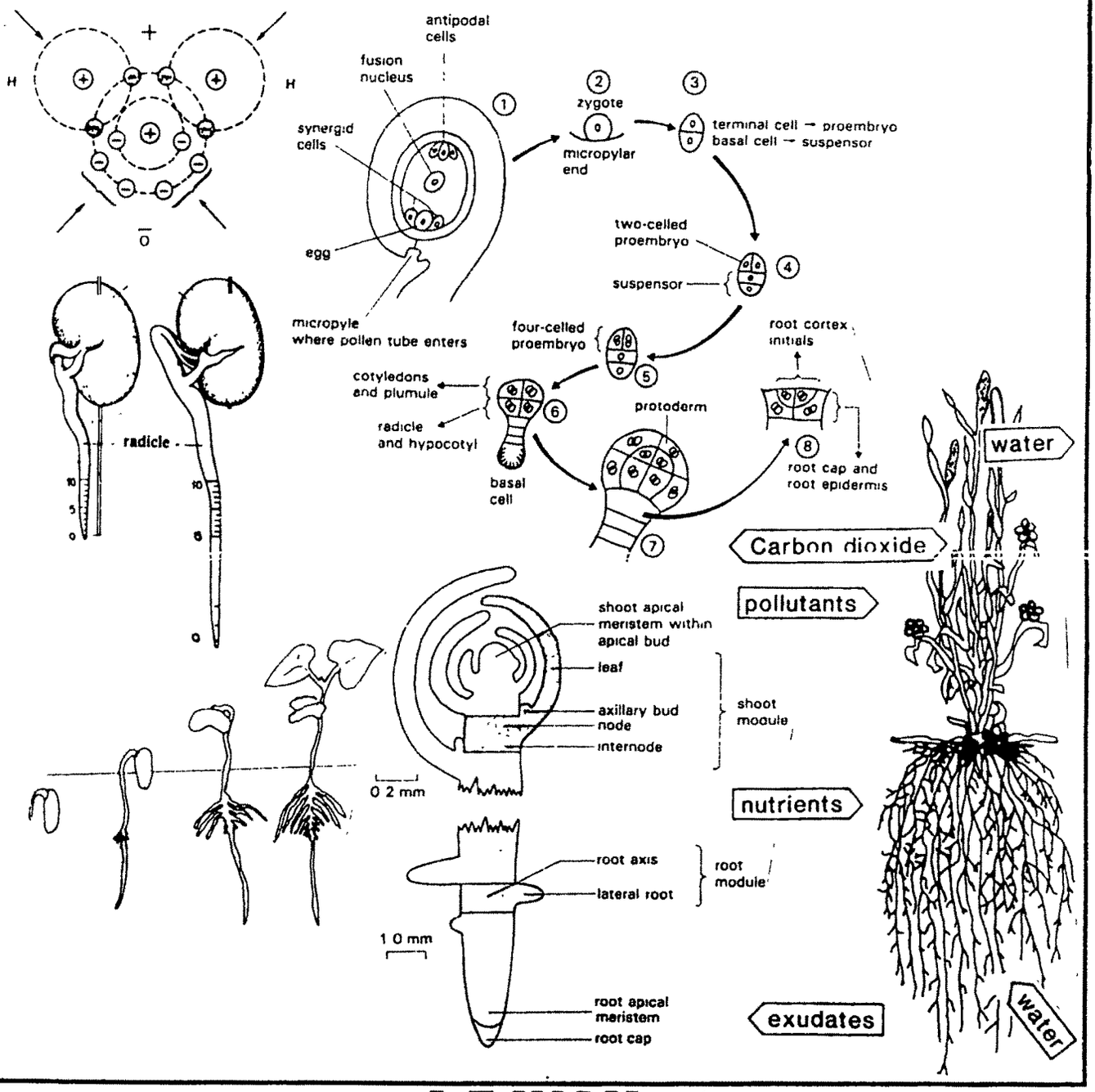
بسم الله الرحمن الرحيم

الدرس الثاني: الماء و النبتات

CHAPTER II: WATER & PLANTS



A.T.INAM

CHAPTER TWO

'LIFE CYCLE OF PLANTS'

In the previous chapter I have discussed the 'Cycle of Water'. In this chapter, I will discuss the impact of water on earth to create life.

As soon as the rainy water falls on earth, the dead seeds hidden beneath the earth revive and show the signs of life by imbibing the 'Rainy Water', as Qoran says: وَلَا حَبَّةٍ فِي ظُلُمَاتِ الْأَرْضِ ... ○ (7-الانعام-59)

وَمَا أَنْزَلَ اللَّهُ مِنَ السَّمَاءِ مِنْ مَاءٍ فَأَحْيَا بِهِ الْأَرْضَ بَعْدَ مَوْتِهَا ... ○ (2-البقرة-164)
حَبَّةٍ مِنْ خَرْدَلٍ ... ○ (21-لقمٰن-16)

Due to 'Rehydration' each and every cell of the seed receive water and 'Metabolic Activities' within the cells start. Thus, germination starts in the seeds and signs of life appear on the earth:

أَوَلَمْ يَرَوْا أَنَّا نَسُوقُ الْمَاءَ إِلَى الْأَرْضِ الْجُرُزِ فَنُخْرِجُ بِهِ زَرْعًا ... ○ (32-السجدة-27)

The 'Radicle' and 'Plumule' develop during the germination. Radicle changes to Root and Plumule changes to Shoot during the phases of growth:

إِنَّهَا شَجَرَةٌ تَخْرُجُ فِي أَصْلِ الْجَحِيمِ ○ طَلْعُهَا كَأَنَّهُ رُءُوسُ الشَّيَاطِينِ ○ فَإِنَّهُمْ لَآكِلُونَ مِنْهَا فَمَالِئُونَ مِنْهَا الْبُطُونَ ○ (23-الصّٰفّٰت-62-66)

Ultimately, the cells of Root & Shoot multiply, elongate and become mature to give the plant a particular shape and size. Root normally, hides beneath the earth and grows towards the gravity, while shoot grows towards the sun and bears stem, branches*, leaves**, flowers and fruits:

وَمِنْ آيَاتِهِ أَنَّكَ تَرَى الْأَرْضَ خَاشِعَةً فَإِذَا أَنْزَلْنَا عَلَيْهَا الْمَاءَ اهْتَزَّتْ وَرَبَتْ ... ○ (39-فصّلت-24)

فِيهِمَا فَاكِهَةٌ وَالنَّخْلُ ذَاتُ الْأَكْمَامِ ○ وَالْحَبُّ ذُو الْعَصْفِ وَالرَّيْحَانُ ○ (21-الرحمٰن-11,12)

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*(48-الرحمٰن-11-27) ** (7-الانعام-39)

LIFE CYCLE OF PLANTS ... contd...

The plants ultimately dehydrate and die*:

كَمَثَلِ غَيْثٍ أَعْجَبَ الْكُفَّارَ نَبَاتُهُ ثُمَّ يَهِيجُ فَتَرَاهُ مُصْفَرًّا ثُمَّ يَكُونُ حُطَامًا ...٥

(الحديد-20)

This chapter contains the following four sub-chapters:

1) Rehydration/Germination

2) Growth

3) Maturation

4) Dehydration & Death

The first sub-chapter of chapter II, contains the Qoranic & scientific details of revival of life in dormant seeds.

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* كُلُّ مَنْ عَلَيْهَا فَانٍ ﴿ (الرحمن-26) (27 - 1)

sub chapter i

Rehydration & Germination:

As soon as Allah The Almighty rain falls from sky, the dead seeds beneath the earth imbibe water molecules and get alive. Infact, during the process of 'Rehydration' water molecules influence the revival of metabolic activities of each rehydrated cells of the seed The rehydrated seed later shows the sign of germination. The process of seed germination is the evidence of life on the earth:

أَوَلَمْ يَرَوْا أَنَّا نَسُوقُ الْمَاءَ إِلَى الْأَرْضِ الْجُرُزِ فَنُخْرِجُ بِهِ زَرْعًا... ٥ (21- السجدة - 27)

The following Qoranic Verse confirms that water is must for life:

أَنْزَلَ مِنَ السَّمَاءِ مَاءً لَّكُم مِّنْهُ شَرَابٌ وَمِنْهُ شَجَرٌ فِيهِ تُسِيمُونَ ٥ يُنبِتُ لَكُم بِهِ الزَّرْعَ وَالزَّيْتُونَ وَالنَّخِيلَ وَالْأَعْنَابَ وَمِن كُلِّ الثَّمَرَاتِ ط... (14- النحل- 10,11)

The following Qoranic Verse indicates the process of germination. Due to soaking of water, the seed swells and the seed coat ruptures. The embryo comes out and germination starts:

وَهُوَ الَّذِي أَنزَلَ مِنَ السَّمَاءِ مَاءً فَأَخْرَجْنَا بِهِ نَبَاتَ كُلِّ شَيْءٍ* فَأَخْرَجْنَا مِنْهُ خَضِرًا** ٥
(7- الانعام- 99)

وَمَا أَنزَلَ اللَّهُ مِنَ السَّمَاءِ مِن رِّزْقٍ فَأَحْيَا بِهِ الْأَرْضَ بَعْدَ مَوْتِهَا - ٥ (25- الجاثية 5)

Even the seeds which have very hard seed coats, like coconuts, palms and dates etc. breaks easily by Mercy of Almighty Allah, when ' 'Rehydration' takes place, enabling the 'embryo' to come out of the hard shell:

إِنَّ اللَّهَ فَالِقُ الْحَبِّ وَالنَّوَى ط يُخْرِجُ الْحَيَّ مِنَ الْمَيِّتِ وَمُخْرِجُ الْمَيِّتِ مِنَ الْحَيِّ ط... ٥
يُخْرِجُ الْحَيَّ مِنَ الْمَيِّتِ وَيُخْرِجُ الْمَيِّتَ مِنَ الْحَيِّ وَيُحْيِي الْأَرْضَ بَعْدَ (7- الانعام- 95)
مَوْتِهَا ط... ٥ (21- الروم- 19)

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*Germination

**Radicle & Plumule

Rehydration & Germination ... contd...

Allah The Almighty terms the water as 'Purifier' and 'agent' to alive the dead earth. Purifier means that the water dissolves the particles cause impurity in it and makes the things pure. In other words, I can say that water is the best 'Solvent'. Through this property, water beneath the soil, dissolves the minerals & transports* them to the plants through root by way of 'ascent of sap'. The Water also alives the dead earth; means enable the seeds to rehydrate and germinate, which are hidden beneath the earth:

وَاَنْزَلْنَا مِنَ السَّمَآءِ مَآءً طَهُوْرًا لِّنُحْيِيَ بِهٖ بَلْدَةً مَّيْتًا وَّنُسْقِيَهٗ مِمَّا خَلَقْنَآ اَنْعَامًا وَّاَنَاسِيَّ كَثِيْرًا ۝ (19- الفرقان-48,49)

Again Allah The Almighty explains in the following Qoranic Verses that the dead seeds hidden beneath the dead earth get alive as soon as they imbibe the rainy water and spurt out (germinate) of earth in the form of greenery/farms:

وَمَآ اَنْزَلَ اللّٰهُ مِنَ السَّمَآءِ مِنْ مَّآءٍ فَاَحْيَا بِهِ الْاَرْضَ بَعْدَ مَوْتِهَا... ۝ (2-البقرة-164)

وَلَئِنْ سَاَلْتَهُمْ مَّنْ نَّزَّلَ مِنَ السَّمَآءِ مَآءً فَاَحْيَا بِهِ الْاَرْضَ مِنْۢ بَعْدِ مَوْتِهَا لَيَقُوْلُنَّ اللّٰهُ ۝ (21-العنكبوت-63)

وَيُنَزِّلُ مِنَ السَّمَآءِ مَآءً فَيُحْيِيْ بِهِ الْاَرْضَ بَعْدَ مَوْتِهَا... ۝ (21-الروم-24)

فَانْظُرْ اِلٰٓى اٰثٰرِ رَحْمَتِ اللّٰهِ كَيْفَ يُحْيِ الْاَرْضَ بَعْدَ مَوْتِهَا... ۝ (21-الروم-50)

وَالَّذِيْ نَزَّلَ مِنَ السَّمَآءِ مَآءً بِقَدَرٍ فَاَنْشَرْنَا بِهٖ بَلْدَةً مَّيْتًا... ۝ (25-الزخرف-11)

اِعْلَمُوْٓا اَنَّ اللّٰهَ يُحْيِ الْاَرْضَ بَعْدَ مَوْتِهَا قَدْ بَيَّنَّا لَكُمُ الْاٰيٰتِ لَعَلَّكُمْ تَعْقِلُوْنَ ۝ (27-الحديد-17)

فَاَنْزَلْنَا بِهِ الْمَآءَ فَاَخْرَجْنَا بِهٖ مِنْ كُلِّ الثَّمَرٰتِ... ۝ (8-الاعراف-57)

وَاَنْزَلْنَا مِنَ السَّمَآءِ مَآءً فَاَنْۢبَتْنَا فِيْهَا مِنْ كُلِّ زَوْجٍ كَرِيْمٍ ۝ (21-لقمان-10)

وَّاَنْزَلْنَا مِنَ الْمُعْصِرٰتِ مَآءً ثَجَّاجًا لِّنُخْرِجَ بِهٖ حَبًّا وَّنَبَاتًا (30-النبا-14,15)

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*when root is cut, ascent of sap/transportation of minerals & water is disrupted and overall growth is blocked.

Rehydration & Germination ...contd...

Allah The Almighty reveals in Qoran that all lives in this world bases on the fact that Allah The Almighty rains pure water from the sky that alives the earth i.e. 'germination', and plants come out of the earth:

وَاللّٰهُ اَنْزَلَ مِنَ السَّمَآءِ مَآءً فَاَحْيَا بِهِ الْاَرْضَ بَعْدَ مَوْتِهَا ؕ اِنَّ فِيْ ذٰلِكَ لَاٰيَةً لِّقَوْمٍ يَّسْمَعُوْنَ ۝ (14-النحل-65)

وَاٰيَةٌ لَّهُمُ الْاَرْضُ الْمَيْتَةُ ۚ اَحْيَيْنٰهَا ... ۝ (23-يٰسٓ-33)

In the following Qoranic Verses Allah The Almighty emphasises that it is 'water' that enables the dead seed to revive its 'metabolic' activities, followed by germination:

اَلَمْ تَرَ اَنَّ اللّٰهَ اَنْزَلَ مِنَ السَّمَآءِ مَآءً فَسَلَكَهٗ يَنَابِيْعَ فِي الْاَرْضِ ثُمَّ يُخْرِجُ بِهٖ زَرْعًا مُّخْتَلِفًا اَلْوَانُهٗ ... ۝ (23-الزمر-21)

وَاخْتِلَافِ الَّيْلِ وَالنَّهَارِ وَمَآ اَنْزَلَ اللّٰهُ مِنَ السَّمَآءِ مِنْ رِّزْقٍ فَاَحْيَا بِهِ الْاَرْضَ بَعْدَ مَوْتِهَا ... ۝ (25-الجاثية-5) وَالَّذِيْٓ اَخْرَجَ الْمَرْعٰى ۝ (30-الاعلى-4)

كَمَثَلِ غَيْثٍ اَعْجَبَ الْكُفَّارَ نَبَاتُهٗ ... ۝ (27-الحديد-20)

How the 'germination' takes place i.e. eruption of plumule by splitting the earth:

اِنَّا صَبَبْنَا الْمَآءَ صَبًّا ۙ ثُمَّ شَقَقْنَا الْاَرْضَ شَقًّا ۙ فَاَنْۢبَتْنَا فِيْهَا حَبًّا ۙ وَّعِنَبًا وَّقَضْبًا ۙ*

وَّزَيْتُوْنًا وَّنَخْلًا ۙ وَّحَدَآئِقَ غُلْبًا ۝ وَّفَاكِهَةً وَّاَبًّا ۙ* (30-عبس-25-31)

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*This is a matter of fact and scientifically proved that for life 'food' is one of the basic needs. And green plants/trees are the only source, capable of synthesise the 'food', that is why they are termed as 'autotrophic'. And such green plants/trees grow, only when the 'rain' falls.

Rehydration & Germination ...contd...

Allah The Almighty created the sky capable to rain and earth capable to 'germinate':

وَالسَّمَآءِ ذَاتِ الرَّجْعِ ۙ وَالْاَرْضِ ذَاتِ الصَّدْعِ ۙ (86-الطارق-11,12)

And Allah The Almighty after that expanded the earth and made it a source of water, which comes up to influence the germination*:

وَالْاَرْضَ بَعْدَ ذٰلِكَ دَحٰىهَا ۙ اَخْرَجَ مِنْهَا مَآءَهَا وَمَرْعٰىهَا ۙ (79-النزعٰت-30) (30,31)

This is the sign of 'Glory' of Almighty Allah that the useless earth which you see becomes capable to germinate** the seeds and enables them to grow (plumule & radicle) and flourish in to greenery when Allah The Almighty rains pure water on it:

وَمِنْ اٰيٰتِهٖۤ اَنَّكَ تَرَى الْاَرْضَ خَاشِعَةً فَاِذَاۤ اَنْزَلْنَا عَلَيْهَا الْمَآءَ اهْتَزَّتْ وَ رَبَتْ ؕ ... ۝ (41-حٰمٓ-39) (24)

Allah The Almighty rains the pure water from sky, which enables the sowed seeds to germinate and turn into green farming, looks pleasant to the farmers:

كَمَثَلِ غَيْثٍ اَعْجَبَ الْكُفَّارَ نَبَاتُهٗ ... ۝ (57-الحدید-20) (26)

And Allah The Almighty made the earth capable to germinate all types of plants & trees, suitably:

وَالْاَرْضَ مَدَدْنٰهَا وَاَلْقَيْنَا فِيْهَا رَوَاسِيَ وَاَنْۢبَتْنَا فِيْهَا مِنْ كُلِّ شَيْءٍ مَّوْزُوْنٍ ۝ (15-الحجر-19) (19)

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*Pasture

**Revitalises/Metabolises the dead seeds.

Rehydration & Germination... contd...

Now, let me review the scientific aspects regarding 'Rehydration' and 'Germination' of seeds. The basic science of Rehydration & Germination absolutely bases on Qoranic Science, though modern science covers the details. But Scientific investigations are no way concern that Rehydration/Germination is one of the stages of the origin of 'Human Creation'.

The following experiment provide us the sufficient evidence that water is the only factor required to rehydrate & germinate the seeds.

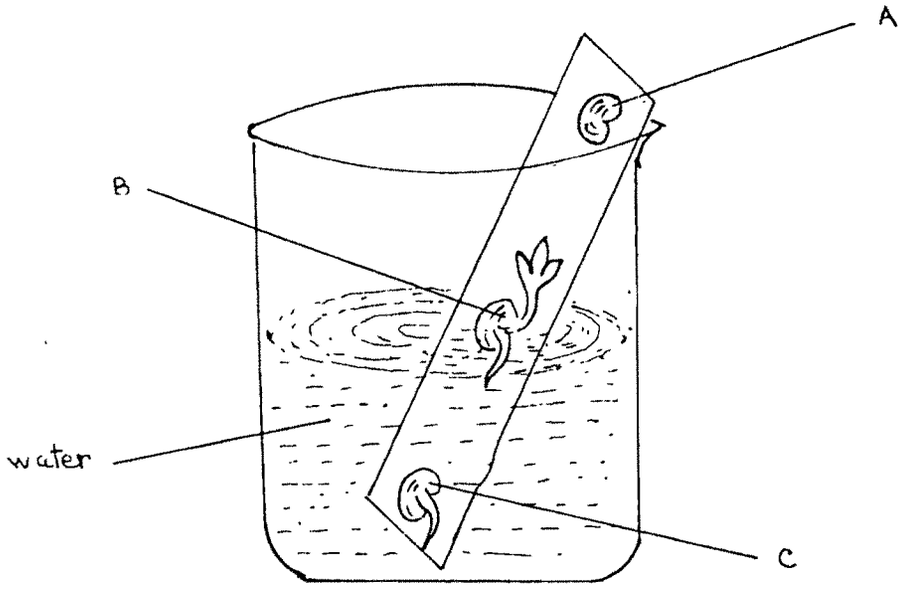

Fig: Demonstration of Rehydration/Germination of seed.

A seed: No water, No Rehydration/Germination

B seed: Suitable supply of water shows maximum 'Germination'.

C seed: shows slight 'germination' since there is excess supply of water.

Rehydration/Germination ...contd...

REHYDRATION:

Germination starts as soon as the seed becomes rehydrated by way of 'imbibition'. During imbibition, cells near the surface of seed become completely rehydrated, whilst cells further away from the surface may remain dry.

Gradual renewal of 'Metabolic' activity during the hours taken to complete the process of water up-take. However, the techniques of Auto Radiography, Microscopy & Electron Microscopy, which allow investigations of individual cell with in a seed, shat that 'PROTEIN' and 'RNA' synthesis are initiated within a cell, almost as soon as that cell has been 'rehydrated'.

The ability to reinitiate the 'metabolism', more or less 'instantly', indicates that the components necessary to sustain metabolism, must survive the dehydration/rehydration process. There is, infact, clear evidence that a mature, dry & quiescent seed does indeed contain the whole range of metabolic & synthetic apparatus, required for an immediate renewal of metabolic activity.

For example, RESPIRATION, may be reinitiated before the synthesis of new 'Respiratory Enzymes'. 'Protein synthesis can get under way without the need to await the arrival from the 'nucleus' of newly synthesised 'RNA' molecules. 'Protein' synthesis is particularly interesting example of Metabolic Readiness.

Although there is an immediate renewal of metabolic activity on Rehydration, it appears that metabolism in the early stages of germination is not as efficient as normal.

Rehydration . . . contd...

Respiration provides a good example of 'Mitochondria', extracted from 'Pea' seed, early in 'imbibition', exhibit a lower Respiratory Control i.e. less ATP* is made per unit of Oxygen take-up than usual. This suggests that the Metabolic Apparatus, although present, is impaired in some way. This example leads on to the consideration of the possibility that Cellular Components may be damaged by the Dehydration/Rehydration Cycle. So, at least, some of metabolic activities, which occur during early germination is directed at repairing or replacing the damaged components.

The efficiency of mitochondrial ATP, synthesised is restored as components of the inner mitochondrial membrane, and as the 'electron carrier proteins' are made and inserted into the membrane. The membrane systems become less leaky, as Phospholipids Membrane Components are synthesised. Gaps and breaks in DNA** molecules are filled and sealed by action of the 'enzymes'; like DNA Polymeraze & DNA Ligaze. The broken RNA*** molecules are degraded and replaced by newly synthesised undamaged molecules.

RENEWED GROWTH:

Although some of the metabolic activities during early stages of germination is related to repair & replacement process. Ultimately, the renewal of the metabolic activity is directed towards 'growth'. Different parts of 'Embryo' start growing at different times after the onset of 'imbibition'.

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*adenosine tri phosphate
**de-oxy ribo nucleotide
***ribo nucleotide

Renewed Growth ...contd...

In many species, Radicle growth precedes Epicotyle growth by many hours.

Renewal of growth is often first detected by an increase in the fresh weight of growing 'embryo' i.e. embryo axis. In Peas, for example, the fresh weight of embryo axis increases markedly during imbibition and then remain constant for some 18-20 hours. The suitable temprature for this growth is 22 °C to 25 °C. However, at about 22 hours after the onset of imbibition, a fresh weight again starts to increase immediately.

This growth is accompanied by cell **extension** in the Radicle and by the differentiation of the 'Vascular' tissue, some times between 30-40 hours after the onset of imbibition. The elongating Radicle splits the Testa and emerges. This is important to note that growth of Radicle is brought about by **elongation** of pre-existing cells. Cell division is not usually recommenced until after the emergence.

Ultra structurally, the increase in fresh weight is accompanied by 'proliferation' of sub-cellular 'organelles' and 'membrane system In the early stages of germination, for example, synthesis of Mictochondrial Membrane component is largely associated with repair & renewal of membrane, with the consequent restoration of Respiratory Efficiency. However, later on, significant increase in the amount of Respiratory Enzymes occur, and later still, during the Cell Elongation Phase, there is an increase in the number of Mitochondria.

Renewed Growth ...contd...

The Endo Membrane System of the cell i.e. Endoplasmic Reticulum and Golgi Bodies also proliferate. The Golgi Bodies are active in the transport of Poly Saccharide materials to the Cell Walls. Vacuoles arise from the Endoplasmic Reticulum and the expansion of these Vacuoles (by wate take-up) and their subsequent Coalescence, which causes the elongation of the cells Radicle.

In addition to the proliferation of Organelles and membranes, there are also increase in the amounts of many Enzymes. A large proportion of the Enzymes are day to day working Enzymes of the cell, which regulate the vast array of normal metabolic sequence. In addition to these, there is also a significant increase in the activity of those Enzymes specifically associated with the renewal of the Cell Division. These include Ribo Nucleotide Reductaze: a key Enzyme in the synthesis of De-Oxy Ribo Nucleotide (the building blocks for DNA synthesis) and DNA Polymeraze, which synthesise new DNA molecules.

Increase in the amount of Nucleic Acids also occur. The increase in the amounts of Ribosomal RNA (and hence Ribosomes), Transfer RNA and Messenger RNA provide a means of supporting increased rates of Protein synthesis and also a preparation of Cell Division*.

Replication of DNA with the Meristematic cells of the Radicle is clearly a specific preparation for Cell Division.

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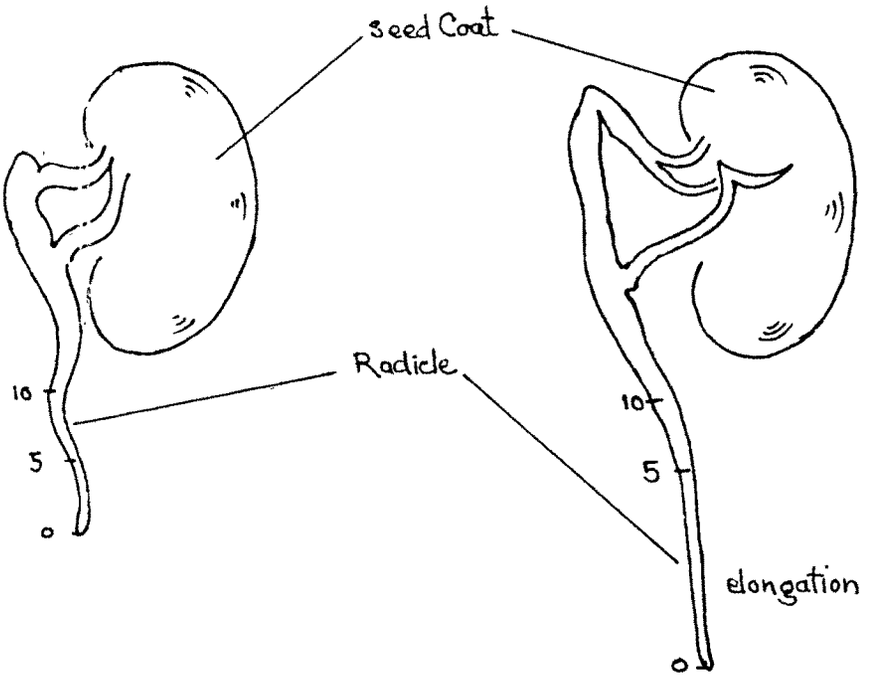
* كَزَرْعٍ أَخْرَجَ شَطْأَهُ فَآزَرَهُ فَاسْتَغْلَظَ فَاسْتَوَىٰ عَلَىٰ سُوقِهِ يُعْجِبُ الزُّرَّاعَ ۗ (29-الفتح-48)

Renewed Growth ...contd...



In the Peas and its relatives, DNA replication is initiated at about the same time as the start of the large scale accumulation of RNA, but in many other species, including Tomato & Radish, DNA replication occurs some what later than the onset of RNA accumulation. Some hours after the initiation of DNA replication, the Cell Division* itself is initiated. As has been emphasized already, the early growth of the Radicle is achieved by Cell Elongation, without addition of any new cell. Cell Division is, thus a relatively late event, occuring well after the emergence of 'Radicle'.

The next sub-chapter ii, contains the explanation of Qoranic Verses regarding plant growth.

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*There is no cell division during the stage of germination. Cell division starts with the process of growth.

sub chapter 11

GROWTH:

During 'germination', rehydration & revival of metabolic activities take place, which cause the 'elongation' of Radicle. Next to the germination is 'Growth'.

Allah The Almighty indicates in Qoran that water plays important role during the growth. The germinating seed-lings grow into the gardens of big trees and some seed-lings grow into small plants (herbs) which die soon i.e. span of herb's life period is short. Herbs produce 'cereals' while tree's span of life period is long i.e. takes much time to grow and mature and ultimately produces bunch of dates i.e. fruits. When dates/fruits become ripe, they attract the people and are means of food for humen:

وَنَزَّلْنَا مِنَ السَّمَآءِ مَآءً مُّبٰرَكًا فَاَنْۢبَتْنَا بِهٖ جَنّٰتٍ وَّحَبَّ الْحَصِيْدِ ۙ وَالنَّخْلَ
بٰسِقٰتٍ لَّهَا طَلْعٌ نَّضِيْدٌ ۙ رِّزْقًا لِّلْعِبَادِ ۙ وَاَحْيَيْنَا بِهٖ بَلْدَةً مَّيْتًا ؕ ۛ (ق-26-11-9)

وَالْبَلَدُ الطَّيِّبُ يَخْرُجُ نَبَاتُهٗ بِاِذْنِ رَبِّهٖ ۚ وَالَّذِيْ خَبُثَ لَا يَخْرُجُ اِلَّا نَكِدًا ؕ ۛ (الاعراف-8-58) *

In the Qoranic text, Allah The Almighty indicates that the 'root', which is generally underground, supplies the water & underground contents like minerals to the rest parts of the plants/trees, through 'root'. If root is cut, supply will be disconnected:

فَاِذَا هُمْ مُّبْلِسُوْنَ ۝ فَقُطِعَ دَابِرُ الْقَوْمِ الَّذِيْنَ ظَلَمُوْا ؕ ۛ (الانعام-7-44-45)

وَيَقْطَعَ دَابِرَ الْكٰفِرِيْنَ ۙ (الانفال-9-7) وَقَطَّعْنَآ اَمَمًا ۚ وَقَطَّعْنَا دَابِرَ الَّذِيْنَ كَذَّبُوْا بِاٰيٰتِنَا ۚ (الاعراف-8-168)

كَشَجَرَةٍ خَبِيْثَةِ ِۨ اجْتُثَّتْ مِنْ فَوْقِ الْاَرْضِ مَا لَهَا مِنْ قَرَارٍ (ابراهيم-13-26)

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*Ferterlity depends on the richness of soil with minerals & root translocates for sound growth, if root is cut translocation of minerals will be disrupt: (الحجر-15-66)

Growth ...contd...

Allah The Almighty make use of (during the growth of plants) air contents in the sky and soil contents beneath the earth:

لَهٗ مَا فِی السَّمٰوٰتِ وَمَا فِی الْاَرْضِ وَمَا بَیْنَهُمَا وَمَا تَحْتَ الثَّرٰی ۝ (20-طٰهٰ-6)

* وَمَا تَسْقُطُ مِنْ وَّرَقَةٍ اِلَّا یَعْلَمُهَا وَلَا حَبَّةٍ فِیْ ظُلُمٰتِ الْاَرْضِ ... ۝ (6-الانعام-59)

Allah The Almighty explains the soil contents beneath the earth; like living organizm i.e. bacteria and non-living things like; minerals & other elements and pure sweet drinking water:

اَلَمْ نَجْعَلِ الْاَرْضَ كِفَاتًا ۙ اَحْیَآءً وَّاَمْوَاتًا ۙ وَّجَعَلْنَا فِیْهَا رَوَاسِیَ شٰمِخٰتٍ وَّ اَسْقَیْنٰكُمْ مَّآءً فُرَاتًا ؕ (77-المرسلٰت-25.27)

This is the 'exhibit' of Almighty Allah's Glory that you see, that Allah The Almighty alives the dead earth, as soon as the rain falls. It means that hidden seeds beneath the earth imbibes the rainy water and start germination and later keep-on growing:

وَمِنْ اٰیٰتِهٖۤ اَنَّكَ تَرَی الْاَرْضَ خَاشِعَةً فَاِذَاۤ اَنْزَلْنَا عَلَیْهَا الْمَآءَ اهْتَزَّتْ وَرَبَتْ ؕ ... ۝ (41-حٰمٓ-24)

Allah The Almighty introgates the non-believers that the seeds they sow are germinated and grown into a full fledged farming by Almighty or they themselves? In fact, by The Almighty Allah:

اَفَرَءَیْتُمْ مَّا تَحْرُثُوْنَ ؕ ءَاَنْتُمْ تَزْرَعُوْنَهٗۤ اَمْ نَحْنُ الزّٰرِعُوْنَ ۝ (56-الواقعة-3.64)

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*The fall of leaf indicates the termination of Photosynthesis; a process during which air & soil contents are utilised to synthesise food and help the process of growth.

Growth . . . contd...

Allah The Almighty reveals in Qoran that the 'day' (when the sun shines) is the source of our food. Allah The Almighty in this regard has created 'sun' in the sky; means that sun supplies the 'solar' energy, while pure water is rained from the sky, which ultimately carries minerals to the plants through root, enabling the plants to synthesise the food. Thus seed grows into plants and plants into garden of trees:

وَّجَعَلْنَا النَّهَارَ مَعَاشًا ۝ وَّبَنَيْنَا فَوْقَكُمْ سَبْعًا شِدَادًا ۝ وَّجَعَلْنَا سِرَاجًا وَّهَّاجًا ۝
وَّاَنْزَلْنَا مِنَ الْمُعْصِرٰتِ مَآءً ثَجَّاجًا ۝ لِّنُخْرِجَ بِهٖ حَبًّا وَّنَبَاتًا ۝ وَّجَنّٰتٍ اَلْفَافًا ۝
* وَاَنْۢبَتْنَا فِيْهَا مِنْ كُلِّ شَيْءٍ مَّوْزُوْنٍ ۝ وَجَعَلْنَا لَكُمْ فِيْهَا مَعَايِشَ (30-النبا - 11-16)
وَمَنْ لَّسْتُمْ لَهٗ بِرٰزِقِيْنَ ۝ (14 - الحجر - 19,20)

Allah The Almighty says that how much He is Merciful to humen to bestow us the control over the earth. Again Allah The Almighty guide us that earth is a 'source' through which you, the humen cultivate your food:

وَلَقَدْ مَكَّنّٰكُمْ فِي الْاَرْضِ وَجَعَلْنَا لَكُمْ فِيْهَا مَعَايِشَ ۭ قَلِيْلًا مَّا تَشْكُرُوْنَ ۝ (8-الاعراف ١٠)

Allah The Almighty again guide us to explain the fertile (good for cultivation) land and non-fertile land (where cultivation is not possible). The fertility of the land is based on the richness of soil contents (minerals & water etc.), which help in the preparation of food:

وَالْبَلَدُ الطَّيِّبُ يَخْرُجُ نَبَاتُهٗ بِاِذْنِ رَبِّهٖ ۚ وَالَّذِيْ خَبُثَ لَا يَخْرُجُ اِلَّا نَكِدًا ۭ
كَذٰلِكَ نُصَرِّفُ الْاٰيٰتِ لِقَوْمٍ يَّشْكُرُوْنَ ۝ (8-الاعراف - ٥٨)

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*This Qoranic Verse indicates that green plants, which Allah The Al-Mighty creates/germinates & grows are 'autotrophic' and not the 'hete rotrophic', since no one provide them food for their survival, but they synthesise their own.

Growth. . . contd...

In the following Qoranic Verse Allah The Almighty indicates that water is required for division, multiplication and elongation of cells of the plants:

إِنَّمَا مَثَلُ الْحَيٰوةِ الدُّنْيَا كَمَآءٍ أَنْزَلْنٰهُ مِنَ السَّمَآءِ فَاخْتَلَطَ بِهٖ نَبَاتُ الْأَرْضِ مِمَّا يَأْكُلُ النَّاسُ وَالْأَنْعَامُ ط ... ٥ (١١ - يونس - 24)

Qoranic Verse reveals that growth of Herbs, Shrubs and Trees in different shape and size require water, whether they are grown on same land or different lands. For example land may be rich in water and mineral salts or may contain poor quantity of water and mineral salt:

وَفِي الْأَرْضِ قِطَعٌ مُّتَجٰوِرٰتٌ وَّجَنّٰتٌ مِّنْ أَعْنَابٍ وَّزَرْعٌ وَّنَخِيلٌ صِنْوَانٌ وَّغَيْرُ صِنْوَانٍ يُّسْقٰى بِمَآءٍ وَّاحِدٍ ق وَنُفَضِّلُ بَعْضَهَا عَلٰى بَعْضٍ فِي الْأُكُلِ ط إِنَّ فِي ذٰلِكَ لَاٰيٰتٍ لِّقَوْمٍ يَّعْقِلُوْنَ ٥ (13 - الرعد - 4)

Qoran again reveals that germinating seeds grow into full fledged trees, when Allah The Almighty rains water from the sky:

وَأَنْزَلَ لَكُمْ مِّنَ السَّمَآءِ مَآءً ج فَأَنْبَتْنَا بِهٖ حَدَآئِقَ ذَاتَ بَهْجَةٍ ج مَا كَانَ لَكُمْ أَنْ تُنْبِتُوْا شَجَرَهَا ط ... ٥ (20 - النمل - 60)

Allah The Almiighty emphasises that Chlorophyll is the most important factor found within the leaf to continue the process of growth:

مُدْهَامَّتٰنِ ٥ (27 - الرحمٰن - 64)

Allah The Almighty indicates that contents of sky like sun & gases and contents of earth like water & minerals are useful for us i.e. help the vegetation: ٥... وَسَخَّرَ لَكُمْ مَّا فِي السَّمٰوٰتِ وَمَا فِي الْأَرْضِ جَمِيْعًا مِّنْهُ ط

(45 - الجاثية 13)

Growth...contd...

The following Qoranic Verse indicates that lack of water/rain causes 'draught' i.e. dehydration and rainy water brings back the life process in plants i.e. rehydration and revival of metabolic activity

ثُمَّ يَاْتِيْ مِنْۢ بَعْدِ ذٰلِكَ سَبْعٌ شِدَادٌ يَّاْكُلْنَ مَا قَدَّمْتُمْ لَهُنَّ اِلَّا قَلِيْلًا مِّمَّا تُحْصِنُوْنَ ۝
ثُمَّ يَاْتِيْ مِنْۢ بَعْدِ ذٰلِكَ عَامٌ فِيْهِ يُغَاثُ النَّاسُ وَفِيْهِ يَعْصِرُوْنَ ۝ ع (12 - يوسف 48/49)

The rainy water not only help in germination of seeds, but also regarded as the most important factor utilized during growth, maturation and in production of fruits & cereals. Allah The Almighty indicates in Qoran that when a seed germinates and grows into a seedling, it becomes capable to synthesise food during photosynthesis. Food thus obtained is a source of energy during the process of respiration. Energy thus produced is consumed to devide, elongate and mature the cells of the plants:

كَزَرْعٍ اَخْرَجَ شَطْـَٔهٗ فَاٰزَرَهٗ فَاسْتَغْلَظَ فَاسْتَوٰى عَلٰى سُوْقِهٖ يُعْجِبُ الزُّرَّاعَ ... ع
(29 - الفتح - 26)

Allah The Almiighty rains water from the sky. This water gather on the earth in form of different source of water, like stream, river and ground water etc. This water help in the creation of vegetation of different colours i.e. leaves are green, flowers are red, yellow, white, violet and different other colours and fruits are of various colours. Since water is required for the growth of leaf, flowers and fruits, therefore, it might raise upward from the ground i.e. <u>ascent of sap</u>: اَلَمْ تَرَ اَنَّ اللّٰهَ اَنْزَلَ مِنَ السَّمَآءِ مَآءً فَسَلَكَهٗ يَنَابِيْعَ فِي الْاَرْضِ ثُمَّ يُخْرِجُ بِهٖ زَرْعًا مُّخْتَلِفًا اَلْوَانُهٗ ثُمَّ يَهِيْجُ فَتَرٰىهُ مُصْفَرًّا ثُمَّ يَجْعَلُهٗ حُطَامًا ۭ اِنَّ فِيْ ذٰلِكَ لَذِكْرٰى لِاُولِي الْاَلْبَابِ ۝ ع (23 - الزمر - 21)

Growth...contd...

When Allah The Almighty rains water from the sky, germinating seeds grow into full fledged and thick vegetation. The growth continues due to supply of water & minerals via 'ascent of sap' and plants remain fresh & green. Water is lossed from plants by way of 'transpiration', thus, dehydration takes place and plant dies ultimately:

وَاضْرِبْ لَهُمْ مَّثَلَ الْحَيٰوةِ الدُّنْيَا كَمَآءٍ اَنْزَلْنٰهُ مِنَ السَّمَآءِ فَاخْتَلَطَ بِهٖ نَبَاتُ الْاَرْضِ فَاَصْبَحَ هَشِيْمًا تَّذْرُوْهُ الرِّيٰحُ ۭ ۝ (18 - الكهف - 45)

Allah The Almighty provides you foods from below your feet and from above of you i.e. water & minerals from earth which are found beneath our feet, and sun and gases particularly Nitrogen & Carbon Di-Oxide, which are found above our head, are collectively useful during vegetation. The vegetation ultimately produces 'fruits and cereals', which we eat as our food. This Qoranic verse indicates the germination, growth & maturation of the plant and the factors utilized during growth:

وَمَآ اُنْزِلَ اِلَيْهِمْ مِّنْ رَّبِّهِمْ لَاَكَلُوْا مِنْ فَوْقِهِمْ وَمِنْ تَحْتِ اَرْجُلِهِمْ ۭ ۝
(5 - المائدة - 66)

اِنَّهَا شَجَرَةٌ تَخْرُجُ فِيْٓ اَصْلِ الْجَحِيْمِ ۝ طَلْعُهَا كَاَنَّهٗ رُءُوْسُ الشَّيٰطِيْنِ ۝ فَاِنَّهُمْ لَاٰكِلُوْنَ مِنْهَا فَمَالِـُٔوْنَ مِنْهَا الْبُطُوْنَ ۝ (37 - الصّٰفّٰت - 62-66)

In the next continued sub-chapter, I intend to cover the scientific aspects of plant growth.

sub chapter ii

GROWTH...contd...

Now, let me review the scientific aspect regarding 'growth' of plants.

Germination has already been discussed in the previous sub-chapter. Growth is always accompanied by change in form & physiological activity. The identical cells are produced by cell division in an Apical Shoot Meristem enlarge and at the same time become different from the Meristematic cells, by forming, for instance 'Parenchyma' or 'Xylem' or 'Phloem'. In the Meristem the newly formed cells grow first by Plasmatic growth i.e. synthesis of Protoplasm.

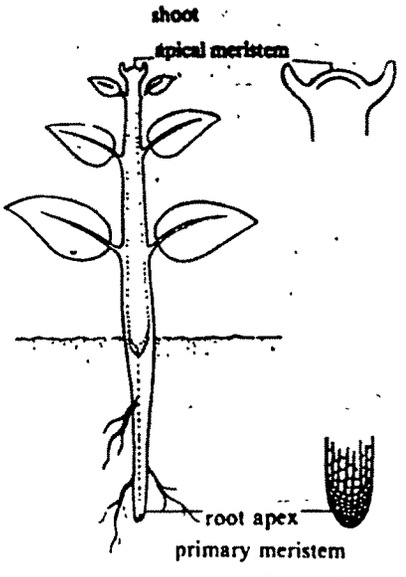


Fig. " ": Apical meristem-shoot and root

وَّزُرُوْعٍ وَّنَخْلٍ طَلْعُهَا هَضِيْمٌ ۚ (الشعراء- 148-19)

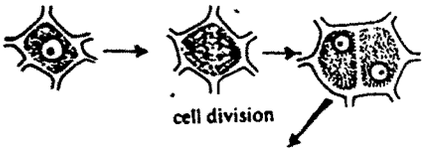
Further growth continues and covers the following phases:

a) Cell Division b) Cell Elongation & c) Cell Maturation or Cell Differentiation.

Growth...contd...

a) Cell Division increases the number of cells, therefore, considerable increase in the amount of Protoplasm. The Cell Divisions are of 3 types:

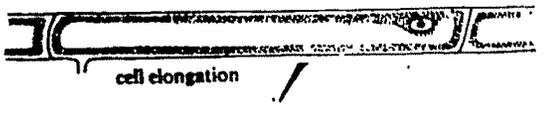
1) Amitosis: It is a direct cell division. In this process Nucleus elongates and devide into two daughter Nuclei by constriction and followed by Cytolasmic Division. This process is rarely seen in living being.



2) Mitosis: Mitosis occurs in the body cells of plants & animals. Each daughter cell contains 2X chromosomes, as of mother.

3) Meiosis: Meiosis occurs in the Reproductive Cells in plants & animals. Each daughter cell receive half number of chromosome (X) than that of mother cell (2X).

b) Cell Elongation: The newly formed cells elongate and enlarge considerably, absorb large amount of water and become turgid. This phase of growth is also called as the 'phase of expansion'. Vacuolation and Cell Wall synthesis take place during this phase.



كَزَرْعٍ أَخْرَجَ شَطْأَهُ فَآزَرَهُ فَاسْتَغْلَظَ فَاسْتَوَىٰ عَلَىٰ سُوقِهِ ... ۝ (الفتح-29)

Growth...contd...

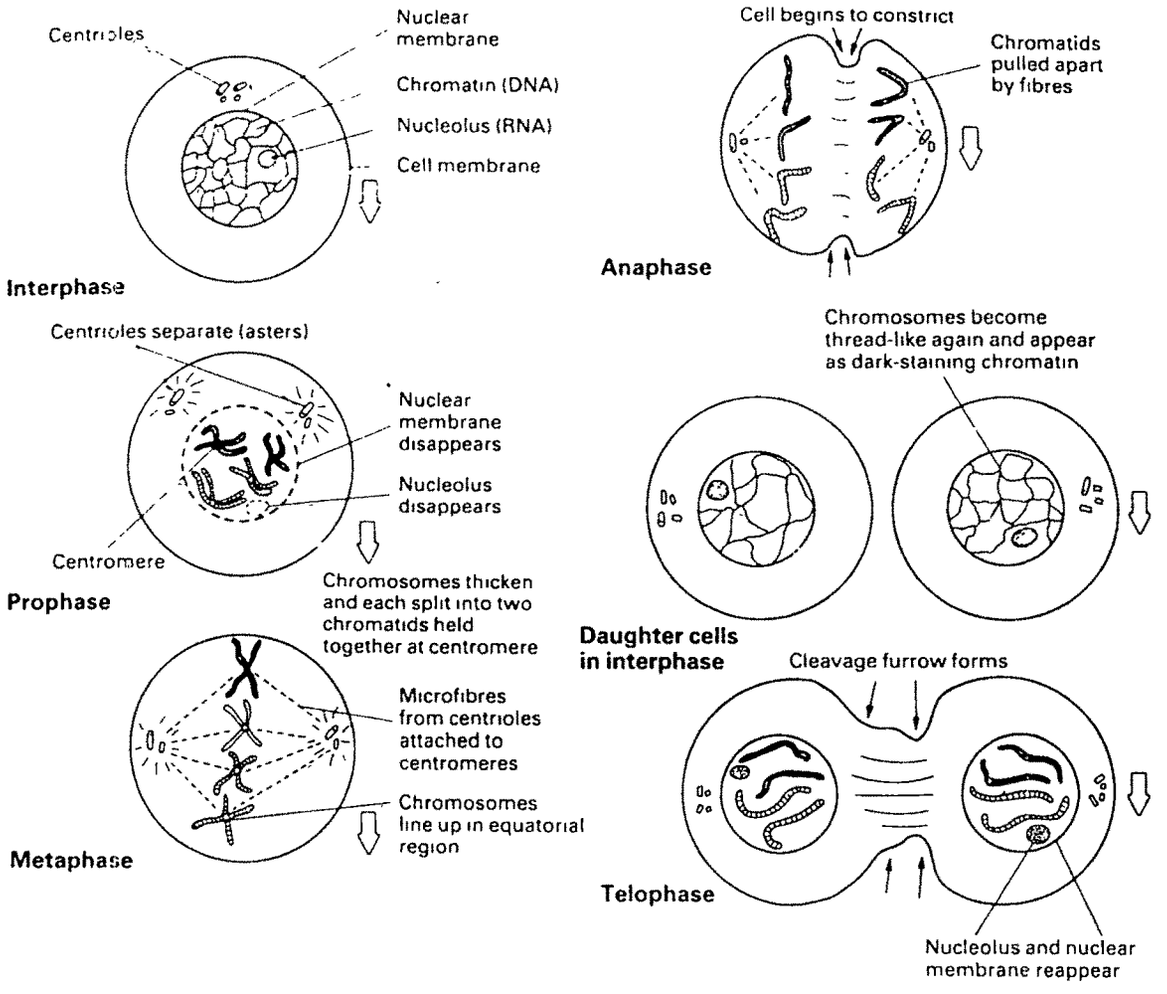


Fig Mitosis—tissue growth

c) Cell Maturation/Differentiation

During this phase expansion of cells slows down and divergence in cell development become dominant, while basic protoplasmic components such as 'Enzyme Proteins' and 'Nucleic Acids' increase in qunatity in all cells. Cell Wall growth occurs in all cells. The completion of differentiation leads to formation of the 'mature' living cells or dead cell elements. The mature tissue cells of 'Parenchyma', 'Collenchyma', 'Sclerenchya', 'Xylem' & 'Phloem' ultimately age and die.

Growth...contd...

Therefore, growth may be defined as 'The synthesis of Protoplasm, usually accompanied by a change in form and an increase in mass of growing system. The total mass increase may be many times that of the increase in the mass of Protoplasmic Components'. In other words growth is an 'irriversible increase in the mass, weight and volume of a living organism, organ or cell'.

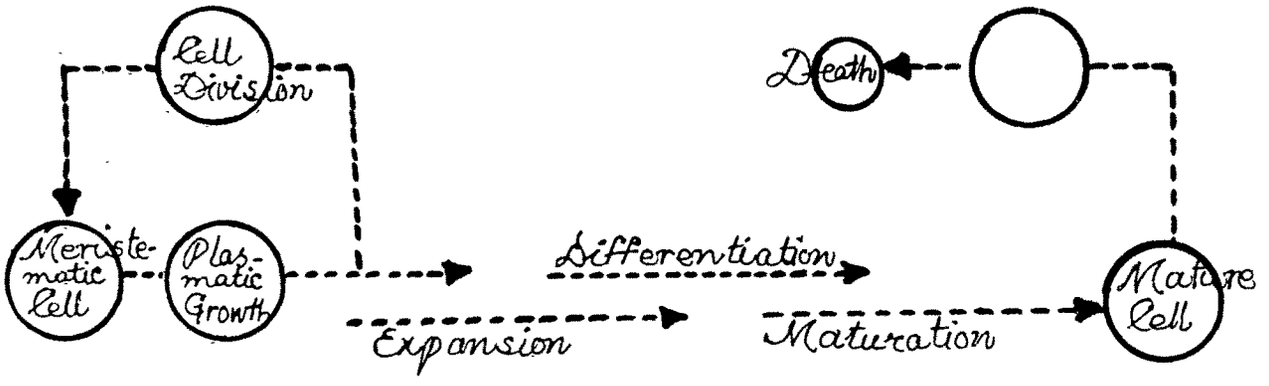


Fig: diagrammatic representation of the sequences of process which constitute the development of a cell of a higher plant.

The flowering plants is characteristically 'autotrophic', obtaining mineral nutrients for its growth from water or soil and manufacturing all its essential 'organic' constituents from Carbon Di-oxide, Water and In-organic ions. Even the young leaves that already are photosynthesising continue to require to import organic nutrients or particular growth hormones. The division and growth of cells of a plant are nurtured by 'metabolites' and growth hormones, synthesised in the specialised tissues of the organism.

Now, let me consider the 'factors' involved during the phases of growth; these are i) Water, ii) Minerals, iii) Mechanism of Translocation, iv) Photosynthesis & v) Respiration.

Growth...contd...

FACTORS INVOLVED DURING GROWTH:

1) Water

2) Minerals

3) Mechanism of Translocation

4) Photosynthesis

5) Respiration

1) Water: Water has already been discussed previously. Liquid water is absolutely necessary for life, because i) It is best solvent and reaction medium of living cell ii) It is reactant in many metabolic processes iii) The hydration of water is associated with 'macro-molecules', and forms part of structure of the 'Protoplasm', existing as 'liquid ice'.

The Physio-Chemical properties of water are unique. Even heavy water De-Uterium Oxide D_2O or De-Uterium Hydraoxide DHO is toxic.

The absorption of water by ROOT through root-hairs, takes place in plants. The main channel for upward movement of water is the 'Xylem' in plants. The 'Root Pressure' and 'Transpiration' pull are Motive Forces in water movement.

2) Minerals: Out of 105 periodic table elements, only limited numbers are essential to the plants. The elements required in large amounts are called 'Macro-elements, while elements required in least amount are called 'Micro-elements'. 'Essential Elements are necessary for growth, while 'Beneficial Elements are not necessary for survival but do promote the growth.

Growth...contd...

ESSENTIAL ELEMENTS		BENEFICIAL ELEMENTS
MACRO NUTRIENTS	MICRO NUTRIENTS	
C, H, O, N	Fe, Mg, Mn,	Na, Cl, Si,
S, P, Ca, K	Cu, Zn, Mo,	Se, Rb, Sr,
(Si)	B, Cl, Co,	
	(Na), (Se)	

The movement of ions within a across the root: EPIDERMIS ---> CORTEX ---> ENDODERMIS ---> STELE ---> XYLEM VESSEL ---> THROUGHOUT THE PLANT BODY:

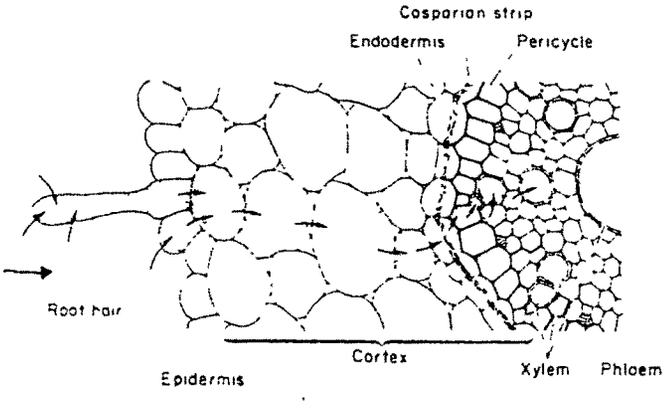


Fig. Diagram of root cross-section, showing the tissues through which water and minerals move when passing from the soil solution to the xylem. (From Esau, 1960, *Plant Anatomy*, Wiley, New York and London.)

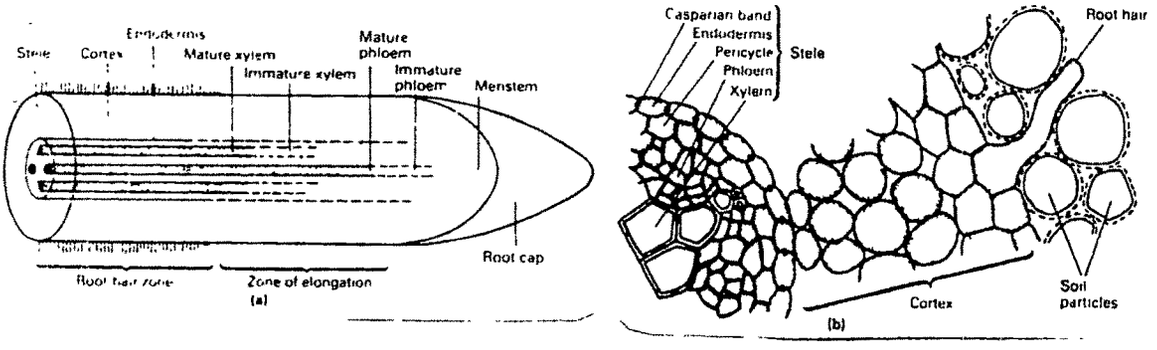


Fig. Root structure. (a) Root tip showing various zones, and the regions of differentiation of xylem and phloem. (b) Transverse section of a root in the root hair zone.

Growth...contd...

3) Mechanism of Translocation: There are certain 'motive forces' involved in translocating the water and minerals from soil to the different parts of the plant via root and Xylem Vessels.

a) Osmosis
b) Diffusion
c) Plasmolysis
d) Cohesion
e) Root Pressure
f) Ascent of Sap
g) Transpiration

a) Osmosis: Osmosis can be defined as 'movement of molecules of a solvent from a region of high partial pressure of a solvent to a region of low partial pressure, when the two regions are separated by a Semi Permeable Membrane'.

A plant cell acts as an Osmotic System in plant. The main components involved in Osmotic Relationships are:

-Cellulose Cell Wall: Non-living with elastic properties, Cellulose Cell Wall is completely permeable to Vacuolar Solutes and thus plays an indirect role in 'Osmotic System'.

-Plasmalemma & Tonoplast: These are outer & inner 'Cytoplasmic Membrane, respectively. Both are partially semi permeable i.e. sugar & inorganic ions pass slowly through them. Experiments have proved that Tonoplast plays more important role than that of Plasmalemma.

Growth (Osmosis) ... contd...

-Cell Sap: The vacuole containing the cell sap is an aquous solution of sugars & minerals.

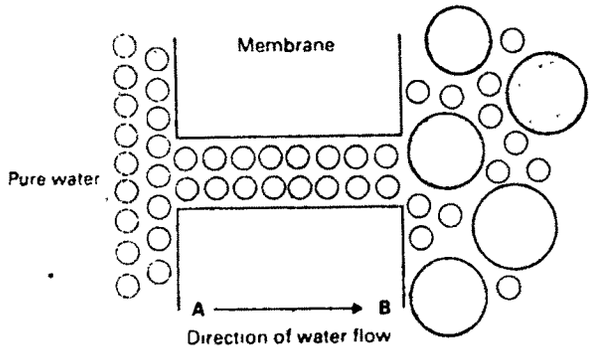
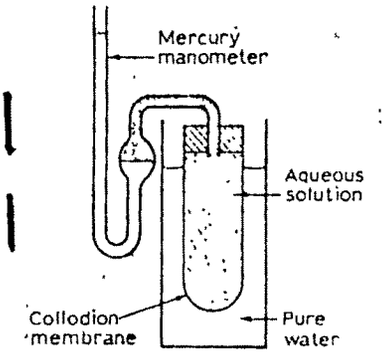


Fig. Flow of water through a pore in a semi-permeable membrane. Water molecules (small circles) fill the pore and a sharp discontinuity exists between water and solution at B. Diffusion of water into the solution causes development of a pressure gradient in the pore which causes bulk flow of water from A to B.



A simple osmometer. For explanation.

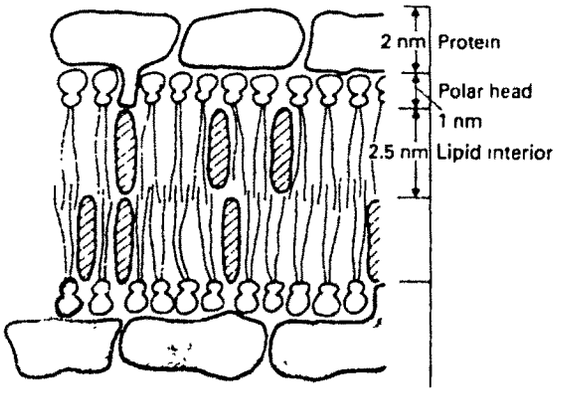


Fig. Tentative model of a biological membrane. The protein on the membrane surfaces is largely in association with the polar heads of phospholipids, but in one instance (top left) it is shown intruding into the hydrophobic lipid interior. The hatched, rod-shaped areas represent lipid molecules such as cholesterol. (From CLARKSON, 1974.)

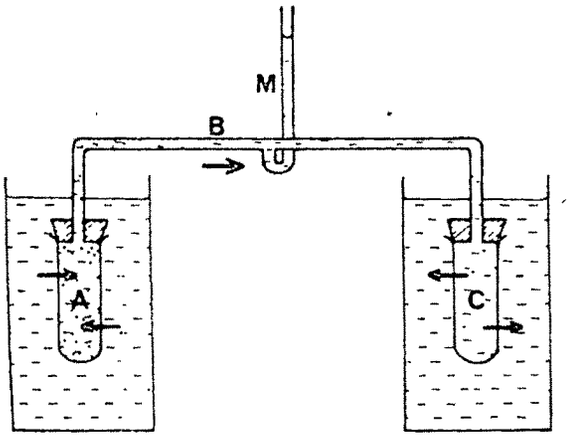
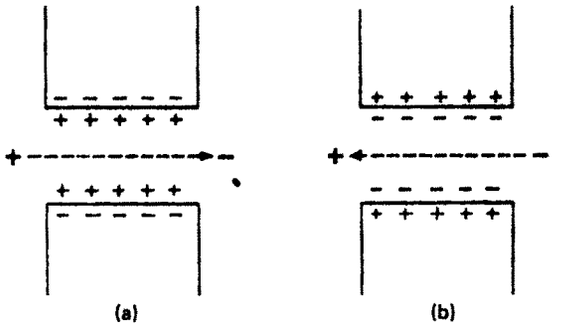


Diagram of an osmotic system in which mass flow of liquid can occur by Munch's hypothesis. See text for explanation.

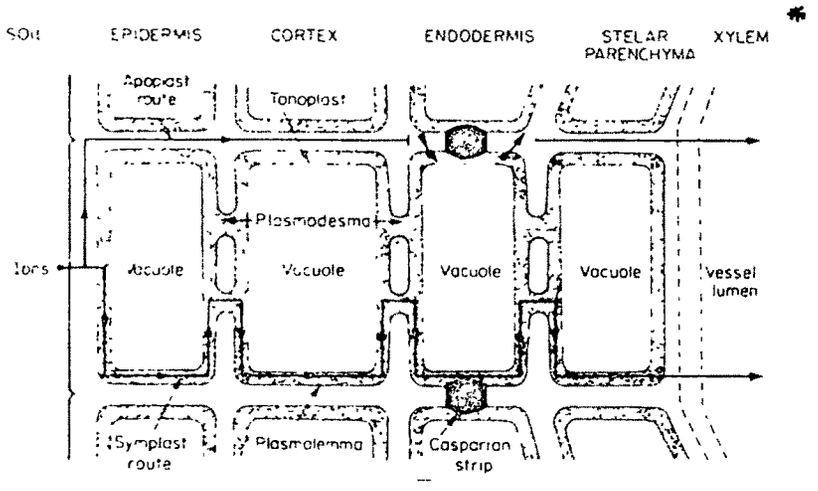


Electro-osmosis. the arrows indicate the direction of flow of wat when the pores of the membrane are charged; (a) –vely; and (b) + vel

Growth ... contd...

b) Diffusion: Diffusion is defined as a 'movement of molecules from region of higher partial pressure to the region of low partial pressure as result of their inherit Kinetic Energy'.

The molecules of a fulid are considered to be in a state of continued random motion. Their direction of movement is in a straight until they collide with another molecule, whereupon, they each will assume a new course at an angle to the original. Since the molecules of a liquid are more densely arranged than in a gas, therefore, chances of collisions in liquid are greater; the path of a molecule 'more' tortuous and the velocity of 'diffusion' is less.



Diffusion in liquid and solid is a discontinuous process, in which some times molecules move rapidly and some times vibrate & rotate at one point. This is due to 'force of attraction' between inside and outside molecules. The Force of Attraction acts as 'Potential Energy Barrier'. When molecules acquire sufficient 'Kinetic Energy' to overcome this 'barrier', a molecule becomes free to diffuse & continues to diffuse until loses its 'Kinetic Energy' due to molecular collision.

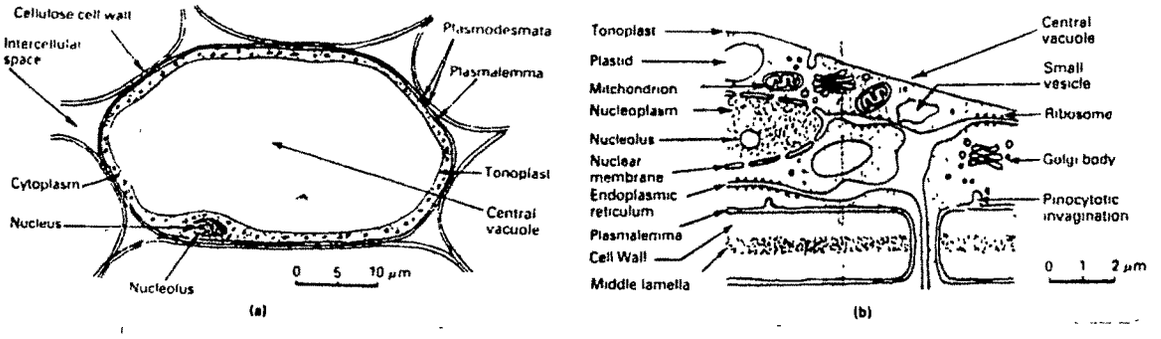
Fig. Possible pathways for ion movement across the root (highly diagrammatic) The cytoplasm forming the symplastic continuum, is stippled The *symplast route* is shown at the bottom, the ions are finally discharged into the apoplast i e xylem vessel walls and lumen, through the plasmalemma of the xylem parenchyma cells The *apoplast route* (top) is interrupted by the Casparian strips (black) which can be bypassed only by entry into the symplast (curved arrow) The passage of ions into vacuoles is not indicated (most of the vacuolar ions remain in the root cells

Growth...contd...

c) Plasmolysis: Plasmolysis indicates the state of equilibrium between 'Cell Sap' & External Solution.

-Limiting Plasmolysis: When Cell Sap and External Solution are "isotonic" i.e. there is no flow of water, neither coming in nor going out.

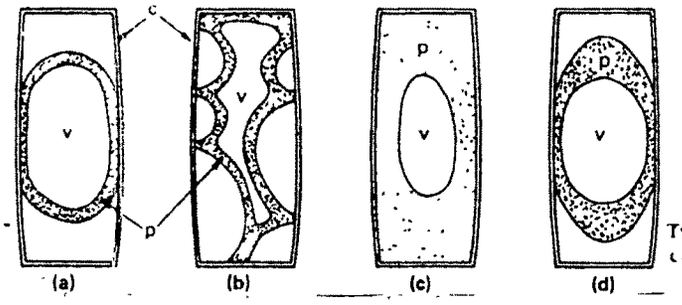
-Incipient Plasmosysis: When external solution is 'Hypertonic', water will be drawn from vacuole. This Process is also called as 'Ex-osmosis'.



Structure of a vacuolated plant cell. (a) Low magnification, (b) ultra-microscopic structure.

-Slight Plasmolysis: Slight plasmolysis is a reversible process of Ex-osmosis, where cell resumes its normal shape, when cell is put into 'Hypotonic' solution. (Endosmosis)

-Advance Plasmolysis: When more advanced plasmolysis takes place, 'Cytoplasm' is damaged and pulled away from the cell wall. The non-living membrane becomes fully 'permeable' and there is rapid 'Ex-Diffusion' of vascular solute from the cell, resulting death of cell



Types of plasmolysis (a) convex, (b) concave, (c) tonoplast, (d) Cap
c = cell wall; p = protoplasm; v = vacuole.

Growth ... contd...

d) Cohesion: Cohesion theory is proposed by Dixon in 1924. Dixon says that there is a strong attraction among water molecules. This force of attraction is known as 'cohesion'. The cohesion in water molecules is so strong that it forms many water column in Xylem Vessel.

Water is given out of leaves by way of 'transpiration'. The space created due to evaporation causes the pull-up of water column held by cohesion. Thus water enters into the leaf. The water is pulled-up from root to stem and finally to leaf.

Cohesion theory has been widely accepted to explain the mechanism of 'ascent of sap'.

e) Ascent of Sap: Water absorbed by root hairs, enters into the Xylem of root. The water contains many dissolved substances. Therefore, such water is termed as 'sap'. From root, sap is transported to the stem and then to the leaves. This upward movement of sap in the plant is called 'Ascent of Sap'.

EXPERIMENT SHOWING ASCENT OF SAP:

If a rooted plant of Balson or a twig of any plant such as 'Neem' is kept in Saffaranin solution for few hours, the veins of leaves become 'red' in colour. If the section of the leaf is observed under microscope, stained Xylem vessels are seen. This also proves that water moves in plants through Xylem.

For figure, please over to the next page.

Growth..Ascent of Sap... contd...

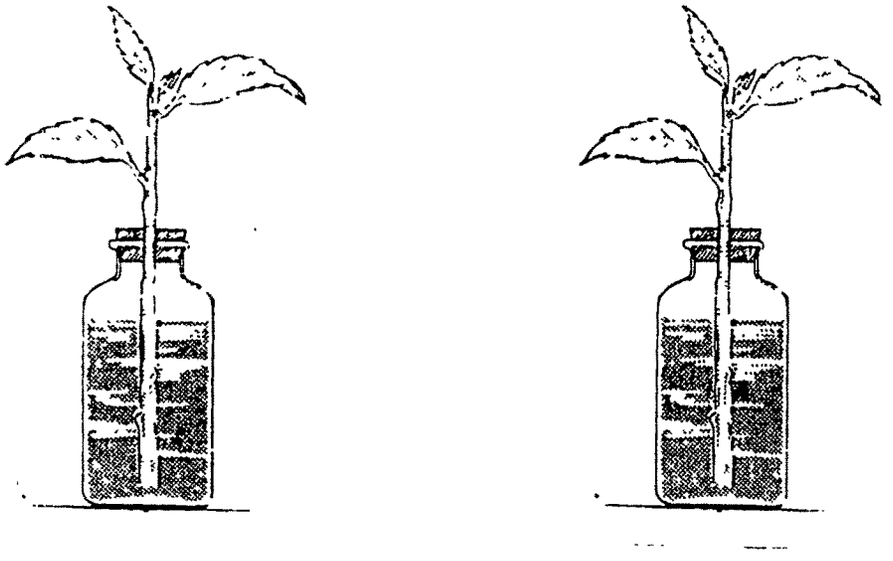


Fig: Path of Ascent of Sap

f) **Root Pressure:** Root hairs absorb water from soil by way of osmosis. From them water diffuses into the neighbouring cells. This way water moves from cell to cell and ultimately reaches to Xylem Vessel. Due to this continuous flow of water, a pressure develops in Xylem Vessel. This pressure is called as 'ROOT PRESSURE'

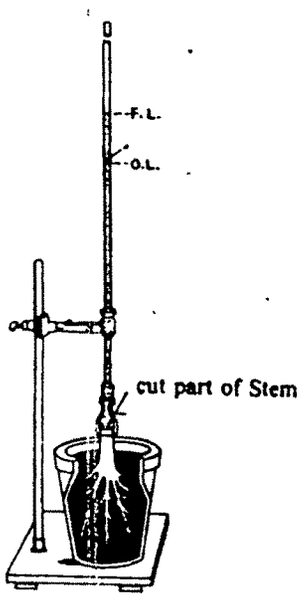
EXPERIMENT DEMONSTRATING ROOT PRESSURE:

A well watered potted plant of Tomato is taken. Its top portion is cut in such a way that only a short piece of stem without any leaf remains above the soil. A glass tube is attached to the cut end of the stem with the help of a rubber tube. The glass tube is filled with water and a drop of oil is placed above the water in the glass tube to check the evaporation. Initial level of water is marked. After few hours, we observe that water level in the glass tube rises. This rise is due to a particular pressure known as 'Root-

Growth ... Root Pressure ... contd

But this Root Pressure is so small that water cannot pushed up to tne top of the tall tree. This theory of Root Pressure is not applicable for water conduction in tall trees.

Fig:



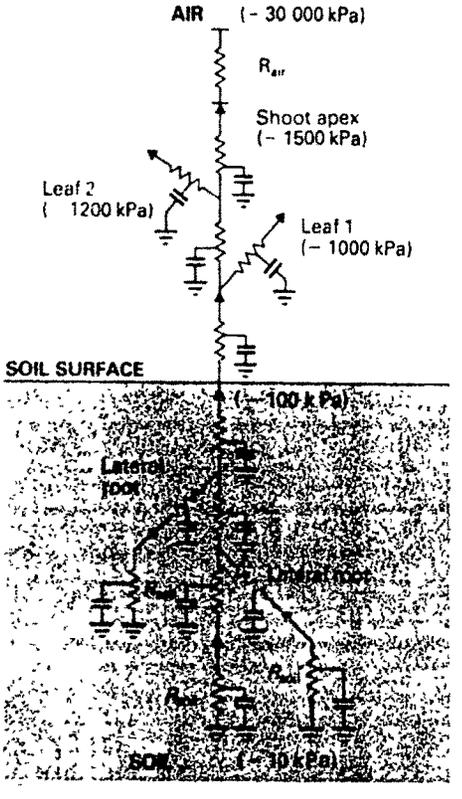


Fig. Pathway of water movement from soil to air through a plant, showing resistances encountered in soil (R_{soil}), root, stem, leaf and air (R_{air}). The capacitors represent the storage capacities of soil and plant parts. Figures show hypothetical fall in water potential in various parts of the system.

g) **Transpiration**: Transpiration can be defined as the loss of water from the surface of a plant. This loss of water takes place from the surface of a plant through 1) Stomata, 2) Cuticle & 3) Lenticles.

1) Stomata Transpiration: 80-90% of transpiration takes place through stomta situated on leaves. In 'herbaceous' plants stomata are found on the epidermis of stem.

Figures regarding stomata, functions of stomata, transpiration, and water & minerals movements through Xylem & Phloem, please*

*over to the next page.

Growth ...Transpiration ...contd...

2) Cuticular Transpiration: About 20% of transpiration takes place through thin cuticles, which are almost an impermeable covering. Loss of water reduces with the increase of thickness of the cuticle, for example in case of Xerophytes & Xeromorphs plants.

3) Lenticular Transpiration: A negligible part of water loses through the lenticles of barks.

EXPERIMENT TO DEMONSTRATE TRANSPIRATION:

The following experiments proves that moisture passes out of the leaf through the stomatal openings. The rate of passing out decreases if these openings are closed. More stomatal openings are present on the lower surface than on the upper surface of leaf.

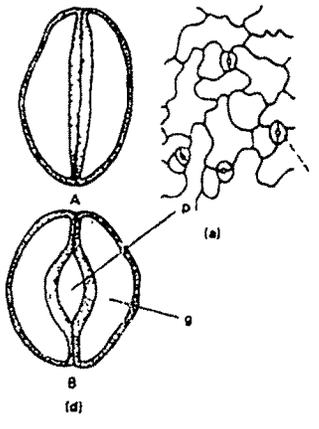


Fig. Morphology of stomata.
(a) *Tropaeolum* (no subsidiary cells),
(d) *Allium*
stoma in the closed (A) and open (B) position
g = guard cell, s = subsidiary cell; e = epidermal cell; p = pore.

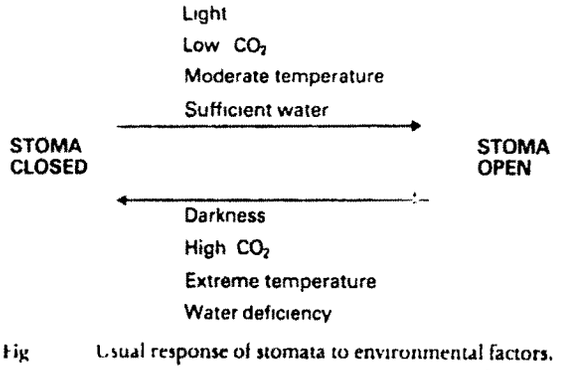


Fig Usual response of stomata to environmental factors.

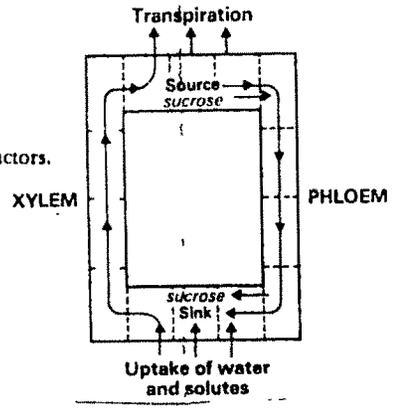


Fig.
Circulation of water in plants according to the ideas of Münsch.

Fig: Transpiration

Planted a seedling in a pot and watered it, then covered the part of the pot around the seedling with plastic paper or rubber being

water proof. This will prevent evaporation of water from the pot. Now, covered the jar with a bell-jar. After some time drops of water will appear on the inner surface of the bell-jar. This water has come out through the stomatal opening of the leaves of the plant. This experiment shows how leaves give out, in the form of vapour, the water absorbed from soil, through root then via stem. Thus, 'transpiration stream' refers to upward movement of water through the Xylem, as a result of 'transpiration'.

The Scientists observe that:

-Transpiration provides the 'motive power' for absorption and translocation of water & mineral salts.

-Transpiration provides a cooling mechanism for the plant.

-Successful growth of the plant achieves under very 'humid' conditions, when the transpiration is very low.

-Transpiration is a 'necessary evil' and plants much have a large area for 'gaseous' exchange.

-It is not possible to have the surfaces of plants freely 'permeable to Oxygen & Carbon Di-oxide but impermeable to water vapour.

Dixon & Jolly have proved that 'cohesive' forces between water molecules, when the water is confined in a narrow tube, is sufficiently high to maintain unbroken columns in the Xylems of highest trees. Dixon & Jolly also observed that water is dragged through the plant as a result of evaporation from the leaves. The energy required for this process is actually 'heat energy' obtained from the sun.

Growth... contd...

4) **Photosynthesis:** During germination and early growth, foods stored in cotyledons of seed are utilized. For the rest period of plant growth, 'photosynthesis*' is responsible to synthesise the food to continue the growth.

Photosynthesis is a process whereby the green plants in the presence of 'light**' convert 'carbon di-oxide' gas from air, and 'inorganic salts' from the soil into the 'organic' substances i.e. 'carbohydrates'. Photosynthesis is important to the plants and animals, as an ultimate source of food. In other words; 'Photosynthesis is a process of 'Carbohydrates' synthesis, in presence of photo/light, absorbed from the sun by the 'chloroplast' and simple 'inorganic sources i.e. carbon di-oxide and water:

$$6\ CO_2 + 6\ H_2O \xrightarrow[Chloroplast]{Light} C_6H_{12}O_6 + 6\ O_2\uparrow$$

FACTORS INVOLVED DURING PHOTOSYNTHESIS:

1) Water
2) Carbon Di-oxide
3) Light
4) Chloroplast

1) **Water:** Water enters the main plant, particularly through the root hairs, travels across the 'Cortex' and moves upward through 'Xylem', ultimately to the 'leaves' where, 'chloroplast' is found, which is capable of absorbing the light.

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* وَجَعَلْنَا النَّهَارَ مَعَاشًا ۝ وَبَنَيْنَا فَوْقَكُمْ سَبْعًا شِدَادًا ۝ وَجَعَلْنَا سِرَاجًا وَهَّاجًا ۝ وَأَنْزَلْنَا مِنَ الْمُعْصِرَاتِ مَاءً ثَجَّاجًا ۝ لِنُخْرِجَ بِهِ حَبًّا وَنَبَاتًا ۝ وَجَنَّاتٍ أَلْفَافًا ۝ (30- النبا- 16-11)

** وَالشَّمْسِ وَضُحَاهَا ۝ وَالْقَمَرِ إِذَا تَلَاهَا ۝ وَالنَّهَارِ إِذَا جَلَّاهَا ۝ وَاللَّيْلِ إِذَا يَغْشَاهَا ۝ (30- الشمس 1)
وَاللَّيْلِ إِذَا يَغْشَى ۝ وَالنَّهَارِ إِذَا تَجَلَّى ۝ وَمَا خَلَقَ الذَّكَرَ وَالْأُنْثَى ۝ (30- اليل- 1-3) ← i.e. plants (36- يس)
وَالضُّحَى ۝ وَاللَّيْلِ إِذَا سَجَى ۝ ... وَأَمَّا بِنِعْمَةِ رَبِّكَ فَحَدِّثْ ۝ (30- الضحى- 11 تا 1,2)

Growth ... Photosynthesis ... contd...

2) Carbon Di-oxide: Carbon Di-oxide is obtained from two sources:

-Carbon Di-oxide from external air, which diffuses through i)Stomata ii)Intercellular spaces of leaves to the wet cell wall of Mesophyll. In the last stage of its movement, Carbon Di-oxide diffuses through the aquous phases of the Walls & Cytoplasm. At this point there is maximum resistance to the diffusion.

-Carbon Di-oxide from the Internal Respiring Cells, including the actual Photosynthesising Cells. In actual photosynthesising cells, carbon di-oxide directly diffuses to the 'Chloroplast' from 'Mitochondria'. From Respiring Cells Carbon Di-oxide diffuses out of the cells through the Inter-cellular spaces of the plant and then as in the case of carbon di-oxide from external air, through the Mesophyll walls, Cytoplasm & finally to the 'Chloroplast'.

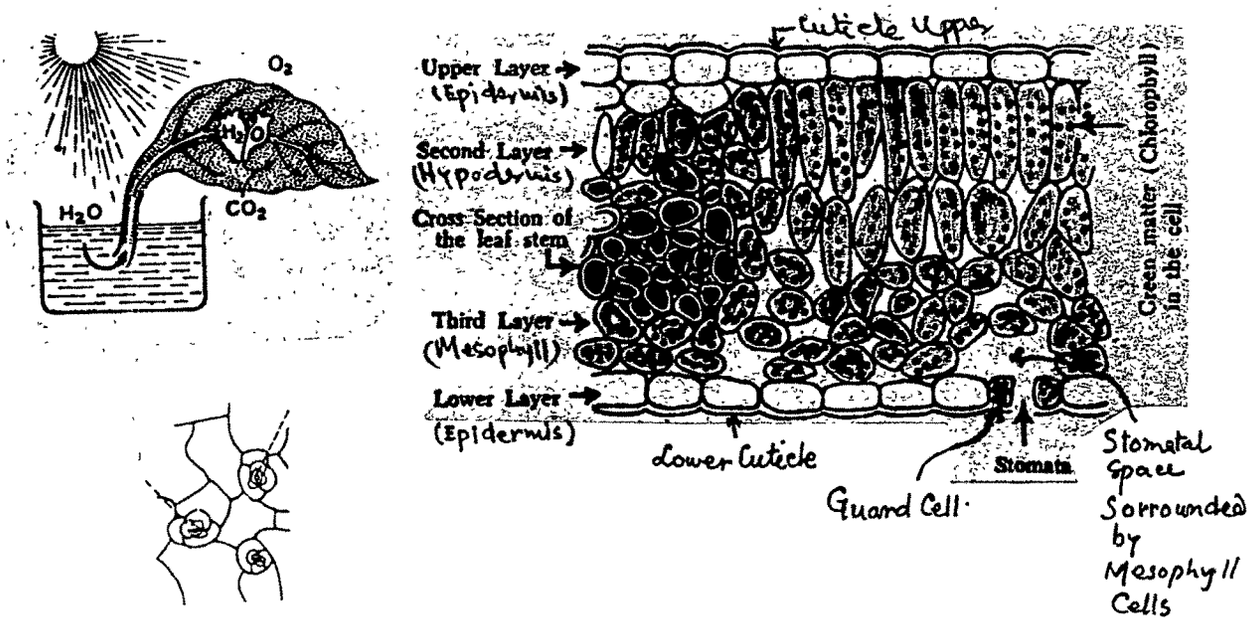

Fig: Showing the diffusion of Carbon Di-oxide gas.

Growth ... Photosynthesis ... contd...

3) Light: Hill showed that 'Light' splits the water molecules, and Hydrogen thus obtained reduces the Ferric ions to Ferrous ions. Water and Ferric ions (as Ferric Oxalate) are available from 'Ascent of Sap': The Hill Reaction's Chemical Equation:

$$4\ Fe^{+++} + 2\ H_2O \xrightarrow[Chloroplast]{Light} 4Fe^{++} + 4H^{+} + O_2$$

If the function of water is to produce a reducing power, then the Photosynthetic Equation will be as follows:

$$CO_2 + 2H_2O \dashrightarrow (CH_2O) + H_2O + O_2$$

In the case of above chemical reaction, water is a Hydrogen 'donor' and consequently producing Oxygen.

In 1954 Arnon proved that Chloroplast, apart from Hill Reaction, also produces ATP, when 'Phosphorus' is supplied externally through 'Ascent of Sap'. Therefore, the Chemical Equation will be as follows:

$$2Fe^{+++} + 2H_2O + ADP + P \xrightarrow[Chloroplast]{Light} 2Fe^{++} + ATP - \tfrac{1}{2}O_2 + 2H^{+}$$

Later, Arnon demonstrated that Cabrohydrate synthesis is based on the free component of the Chloroplast, soluble in water i.e. 'Chlorophyll'. Therefore, Light reaction during Photosynthesis is associated with the Grana of Chloroplast, while Dark Reaction* is associated with the Stroma of Chloroplast.

Structure of Chloroplast:

Chloroplast is an 'organelle' found in the green plants, and is an important type of 'Plastid'. Chloroplast contains water soluble pigment - 'Chlorophyll'.

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*Second part of chemical reaction during photosynthesis when light is not required. (37,38 -يٰسٓ-23)

Growth ... Chloroplast ...contd...

A part from Chlorophyll, chloroplast contains i) protein, ii) Lipids, & iii) small quantity of Carbohydrates along with DNA, RNA & various enzymes reuired for the process of Photosynthesis.

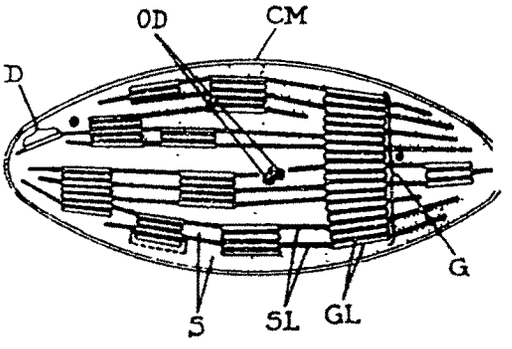

Fig. Interpretation of the structure of a barley chloroplast (as von Wettstein).
Key. CM, chloroplast double membrane (each 35–50 Å thick); S, stroma; G, granum (made up of a cylindrical pile of discs); SL, stroma lamella; GL, grana lamella; D, disc; OD, osmiophilic droplet.
(From S. Granick, in *The Cell*,)

Fig: Structure of Chloroplast

Type of Chlorophyll:

The function of Chlorophyll* is important since it absorbs the light.

Pigment	Formula	Colour
Chlorophyll a	$C_{55}H_{72}O_5N_4Mg$	Green
Chlorophyll b	$C_{55}H_{70}O_6N_4Mg$	Green
Carotene	$C_{40}H_{56}$	Orange
Xanthophyll	$C_{40}H_{56}O_2$	Yellow

Qoran has already indicated the existence of fire in green trees. Fire is tranformation of solar energy. Fire breaks out during friction of branches, as O_2 is available due to photosynthesis: الَّذِي جَعَلَ لَكُمْ مِنَ الشَّجَرِ الْأَخْضَرِ نَارًا فَإِذَا أَنْتُمْ مِنْهُ تُوقِدُونَ (يٰسٓ-80)

* مُدْهَامَّتَانِ (الرحمٰن-64)

Growth ... contd...

5) Respiration**: Respiration in plants means "Transport" of Oxygen to the cell, where Organic Compound; 'Hexose Sugars' combines with the Oxygen to produce Carbon Di-oxide, Water and Energy:

$$(CH_2O) + 6O_2 \longrightarrow 6CO_2 + 6H_2O + Energy^*$$

The oxidation of one molecule of Glucose yields 2880 KJ of free Energy.

TYPES OF RESPIRATION:

a) External Respiration
b) Internal Aerobic Respiration
c) Internal In-aerobic Respiration
d) Fermentation
e) Phtorespiration

a) EXTERNAL RESPIRATION: In green plants the process by which Oxygen is brought to the Respiratory Centre of the cell i.e. 'Mitochondria' is called as 'External Respiration'. This Oxygen intake to the Mitochondria may vary:

-Diffusion of Oxygen from Chloroplast to the Mitochondria, if the plant is illuminated,

-Diffusion of Oxygen from out-side air through Stomata, across the intercellular spaces,

-Diffusion of Oxygen gas to the cell wall, if the plant is placed in the darkness.

* اَلْمِصْبَاحُ فِيْ زُجَاجَةٍ ۖ اَلزُّجَاجَةُ كَاَنَّهَا كَوْكَبٌ دُرِّيٌّ يُّوْقَدُ مِنْ شَجَرَةٍ مُّبٰرَكَةٍ زَيْتُوْنَةٍ لَّا شَرْقِيَّةٍ وَّلَا غَرْبِيَّةٍ ۙ يَّكَادُ زَيْتُهَا يُضِيْٓءُ وَلَوْ لَمْ تَمْسَسْهُ نَارٌ ۭ نُوْرٌ عَلٰي نُوْرٍ ۭ...۝ (النور-35)

** وَالصُّبْحِ اِذَآ تَنَفَّسَ ۝ (التکویر-18)

Growth ... Respiration ... contd...

b) Internal Aerobic Respiration: The oxidation of cellular food i.e. Hexose Sugar, by utilizing molecular Oxygen and producing Energy, is known as Internal Aerobic Respiration or Tissue Respiration. The site of Internal Aerobic Respiration is Mitochondria:

$$(CH_2O) + 6O_2 \dashrightarrow 6CO_2 + 6H_2O + Energy\ 674 Cal.$$

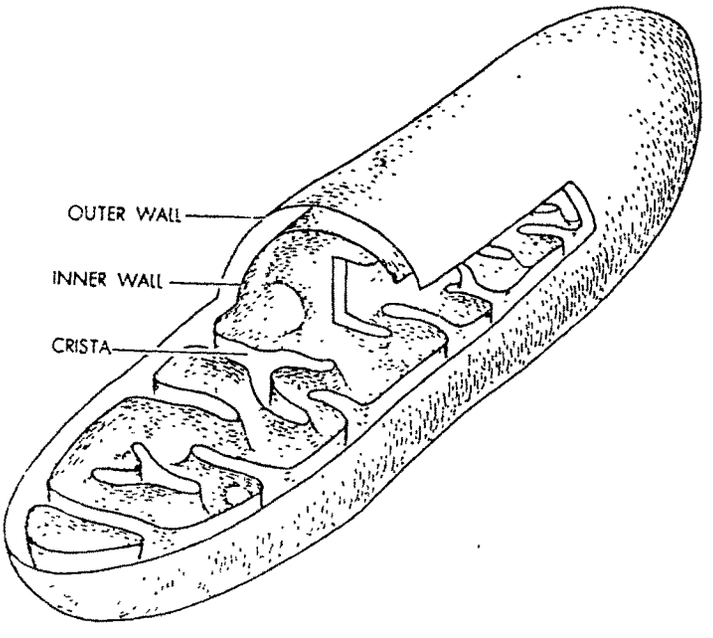

Fig Diagrammatic representation of the structure of a mitochondrion. (After A. L. Lehninger, *Scientific American* Reprint 91, Sept. 1961.)

Fig: Structure of Mitochondria

c) Internal In-Aerobic Respiration: The production of Energy from cellular food material in absence of molecular Oxygen is known as Internal In-Aerobic Respiration. When a plant is placed in an atmosphere lacking Oxygen, the plant produces Carbon Di-oxide, Ethyle Alcohal and Energy:

$$(CH_2O) \dashrightarrow 2C_2H_5OH + 2CO_2 + Energy\ 674 Cal.$$

During the chemical reaction of In-aerobic Respiration, an enzyme is required which acts as a 'catalyst'.

Growth ... Respiration ... contd...

d) Fermentation: Fermentation is a form of Anaerobic Respiration. Anaerobic Respiration carried out by some Fungi & Bacteria in the form of 'Fermentation'.

Apart from 'External Respiration', which is infact a transport mechanism; 'Respiration can be considered as a Process by which cells obtain their supplies of "Energy" by degration of the Complex Compounds'.

During Fermentation, Glucose is utilized to produce energy and ultimate products Pyruvic Acid & Acetal Dehyde:

1) The raising of free energy level of the substrate by Trans-Phosphorylation from ATP:

Glucose + 2ATP ---→ Fructose 1:6 di-phosphate + 2ADP

2) Split of Fructose 1:6 di-phosphate: Aldolaze acts as Catalyst Enzyme

Fructose 1:6 Di-phosphate ---→ Phsphoglygerol Dehyde+Di-hydroxy Aceto Phosphate

Phosphoglycerol Dehyde is utilized & Di-Hydroxy Acetone Phosphate Acetone converts into Phsphoglyeral Dehyde in presence of Catalyst Enzyme 'Triose Phosphate Isomerase':

Di-hydroxy Acetone Phosphate -------→ Phosphoglyceral Dehyde

3) Oxidation of Phosphoglyceral Dehyde by removal of Hydrogen to co-enzyme I(NAD). This reaction involves primarily by HYDROLYSIS and Phosphoglyceric Acid is formed as a free but Phosphoglycerate Enzyme Complex:

a) Phospho Glyceral Dehyde + HOH -------→ Phospho Glyceric Acid

Separation of Enzyme from the complex is achieved by second Phosphorylation i.e. utilizing Inorganic Phosphate, therefore,

1:3 Di Phospho Glyceric Acid is produced at a high Energy level:

b) Phspho Glyceric Acid+NAD+HOP----→$NADH_2$+H_2O+1:3 Di Phospho-Glyceric Acid

4) The Di-Phospho Glyceric Acid undergoes a series of reactions during which high energy Phosphate group is transferred to ADP. This is followed by a substrate Phosphorylation and formation of Pyruvic Acid:

1:3 Di-Phospho Glyceric Acid+2ADP----→Pyruvic Acid+H_2O+2ATP

5) Since two molecules of Phosphoglyceral Dehyde are produced from one molecule of HEXOSE, thus 4 molecules of ATP are produced. Since 2 molecules of ATP were utilized in initial Priming of HEXOSE, therefore, ultimately 2 molecules of ATP are produced from each Glucose molecule:

$CH_3.CO.COOH$ ---→ $CH_3.CHO$ + CO_2 (Decarboxylation of Pyruvic Acid)
Pyruvic Acid — Acetal Dehyde — Acid

$NADH_2$ + $CH_3.CHO$ ----→ $CH_3.CH_2.OH$ + NAD (Reoxidation of $NADH_2$)
Acetal Dehyde — Ethyle Alcohal

When 'Yeat' is allowed to ferment Sugar, the rate of fermentation can be increased by the addition of Inorganic Phosphate (PO_4). This Phosphate is utilized in the formation of A.T.P.

e) Photo-Respiration: In the tissues of 'Chloroplast', the rate of respiration in the 'light' & 'dark' are identical, means, light does not have any effect on the rate of Respiration.

The Qranic Verse (النور-35) has already mentioned the transformation of 'solar' energy into the 'energy' stored within the green trees.

sub chapter iii

MATURATION:

Plants/Trees attain maturity means, plants/trees are in their final shape, size and appearance. Qoran illustrates the stage of maturity of plants/trees that they are properly distinct into:
i) Shoot: the upper part, which grows towards the sky or sun, reches to its maximum height in the sky, bearing flowers & fruits, and ii) Root: which keeps the plants/trees fixed i.e. cannot move the way animals move. The root goes deep into the earth. The depth of the root depends upon the height of the shoot, only then the plants/trees may remain fixed on earth: At maturity the root reaches to its maximum depth:

اَلَمْ تَرَ كَيْفَ ضَرَبَ اللّٰهُ مَثَلًا كَلِمَةً طَيِّبَةً كَشَجَرَةٍ طَيِّبَةٍ اَصْلُهَا ثَابِتٌ وَّفَرْعُهَا
فِي السَّمَآءِ ۝ تُؤْتِيْٓ اُكُلَهَا كُلَّ حِيْنٍ بِاِذْنِ رَبِّهَا ... ۝ (14-ابراهيم - 24,25) (37-الصّٰفّٰت - 23)

The following Qoranic Verse indicates that 'root' is main supplier of nutrients to the rest parts of plants, if cut supply* is blocked:

وَقَطَّعْنَا دَابِرَ الَّذِيْنَ كَذَّبُوْا بِاٰيٰتِنَا ... ۝ (8-الاعراف-72) فَقُطِعَ دَابِرُ الْقَوْمِ الَّذِيْنَ ۝ (7-انعام 45)

In the following Qoranic Verse Allah The Almighty expresses in Qoran that water is not importantly required during the germination, but the supply of water is as much important at the stage of maturity, when shoot is at its maximum height and root is at its maximum depth. The Qoran explains a scientifiic practical; by cutting off the shoot above the earth, leaving the root beneath the earth, the whole plant/tree lost its entity. This practical also proves, that water & minerals from earth are translocated to shoot through the root: وَيَقْطَعَ دَابِرَ الْكٰفِرِيْنَ ۝ (9-الانفال-7) ٤ (14-الحجر-66)

وَمَثَلُ كَلِمَةٍ خَبِيْثَةٍ كَشَجَرَةٍ خَبِيْثَةِ ِۨاجْتُثَّتْ مِنْ فَوْقِ الْاَرْضِ مَا لَهَا مِنْ قَرَارٍ ۝
(14-ابراهيم-26)

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*i.e. overall growth of the plant is terminated. (28-الحشر-5)

sub chapter iii

MATURATION: ... contd.

Growth continues in plants till death. But the ultimate stage of growth is the phase of 'Maturation'. When the plants/trees start to produce the flowers & fruits/cereals, it means the growth enters in its final stage i.e. Maturation*.

Maximum height, weadth, final shape, appearance of flowers & fruits are the signs of maturity, as the Qoran describes:

وَفِي الْأَرْضِ قِطَعٌ مُّتَجٰوِرٰتٌ وَّجَنّٰتٌ مِّنْ اَعْنَابٍ وَّزَرْعٌ وَّنَخِيْلٌ صِنْوَانٌ وَّغَيْرُ صِنْوَانٍ
يُّسْقٰى بِمَآءٍ وَّاحِدٍ ۖ وَنُفَضِّلُ بَعْضَهَا عَلٰى بَعْضٍ فِي الْاُكُلِ ۭ اِنَّ فِيْ ذٰلِكَ
لَاٰيٰتٍ لِّقَوْمٍ يَّعْقِلُوْنَ ۝ (13 - الرعد - 4)

The appearance of fruits are sign of maturity, but the growth retard i.e. the growth of fruits retards if supply of underground water minerals are blocked by some foreign organisms, life fungus, bacteria and insects, by Will of Almighty Alllah:

فَاَعْرَضُوْا فَاَرْسَلْنَا عَلَيْهِمْ سَيْلَ الْعَرِمِ وَبَدَّلْنٰهُمْ بِجَنَّتَيْهِمْ جَنَّتَيْنِ ذَوَاتَيْ اُكُلٍ
خَمْطٍ وَّاَثْلٍ وَّشَيْءٍ مِّنْ سِدْرٍ قَلِيْلٍ ۝ (22 - سبا - 16)

Allah The Almighty clarifies in Qoran that a seed germinates, grows and confirms the maturity by giving rise seven branches and atleast, one hundred seeds/cereals are produced out of that one seed sowed:

كَمَثَلِ حَبَّةٍ اَنْۢبَتَتْ سَبْعَ سَنَابِلَ فِيْ كُلِّ سُنْۢبُلَةٍ مِّائَةُ حَبَّةٍ ۭ وَاللّٰهُ يُضٰعِفُ
لِمَنْ يَّشَاۗءُ ۭ وَاللّٰهُ وَاسِعٌ عَلِيْمٌ ۝ (3 - البقرة - 261)

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*when growth reaches towards the stage of saturation.

Maturation... contd...

Qoran indicates that water is required not only for germination, but required for the all the phases of growth, including during the production of flowers & fruits. In the following Verse, Qoran narrates that rate of fruit production doubles, if it rains heavily, otherwise, water obtained from dew drops will be sufficient to produce fruits normally:

كَمَثَلِ جَنَّةٍۭ بِرَبْوَةٍ أَصَابَهَا وَابِلٌ فَـَٔاتَتْ أُكُلَهَا ضِعْفَيْنِ ۚ فَإِن لَّمْ يُصِبْهَا وَابِلٌ
فَطَلٌّ ۗ وَٱللَّهُ بِمَا تَعْمَلُونَ بَصِيرٌ ۝ (3-البقرة-265)

Pure, sweet and fresh water which Allah The Almighty rains from the sky; not only quenches our thirst, but also grows the seed into big tree. The growth of all types of vegetation; like Herbs, Shrubs & Trees are possible if supplied with water. This growth continues till they become mature enough to produce flowers & fruits of different varieties:

هُوَ ٱلَّذِىٓ أَنزَلَ مِنَ ٱلسَّمَآءِ مَآءً لَّكُم مِّنْهُ شَرَابٌ وَمِنْهُ شَجَرٌ فِيهِ تُسِيمُونَ ۝
يُنۢبِتُ لَكُم بِهِ ٱلزَّرْعَ وَٱلزَّيْتُونَ وَٱلنَّخِيلَ وَٱلْأَعْنَابَ وَمِن كُلِّ ٱلثَّمَرَٰتِ ۗ إِنَّ
فِى ذَٰلِكَ لَـَٔايَةً لِّقَوْمٍ يَتَفَكَّرُونَ ۝ (14-النحل-10,11)

ذَوَاتَآ أَفْنَانٍ ۝ (27-الرحمٰن-48)

The shoot of a tree contains <u>stem</u> which is generally multi-branched: Again, Qoran narrates that Allah The Almighty rains water from the sky. Due to this rain, every sort of seeds start to germinate and appear coming out of earth. Some of the germinating seed grows into Herbs, some of them appears in the form of Shrubs, and some of them appears like tree. Later, these become mature to produce the 'Cereals' from Herbs, 'Grapes' from the Shrubs and 'Dates, Olive &

Maturation ... contd...

Pomegranates' etc. from Trees. Growth continues till these cereals and fruits ripe. Ripening of fruits and cereals, invite the wise people to ponder over these changes:

وَهُوَ الَّذِيْٓ اَنْزَلَ مِنَ السَّمَآءِ مَآءً ۚ فَاَخْرَجْنَا بِهٖ نَبَاتَ كُلِّ شَيْءٍ فَاَخْرَجْنَا مِنْهُ خَضِرًا نُّخْرِجُ مِنْهُ حَبًّا مُّتَرَاكِبًا ۚ وَمِنَ النَّخْلِ مِنْ طَلْعِهَا قِنْوَانٌ دَانِيَةٌ وَّجَنّٰتٍ مِّنْ اَعْنَابٍ وَّالزَّيْتُوْنَ وَالرُّمَّانَ مُشْتَبِهًا وَّغَيْرَ مُتَشَابِهٍ ۗ اُنْظُرُوْٓا اِلٰى ثَمَرِهٖٓ اِذَآ اَثْمَرَ وَيَنْعِهٖ ۗ اِنَّ فِيْ ذٰلِكُمْ لَاٰيٰتٍ لِّقَوْمٍ يُّؤْمِنُوْنَ ۝ (7- الانعام- ۹۹)

فَاَصْبَحَتْ كَالصَّرِيْمِ ۝ (29 - القلم-۲۵) ↓

Mature fruits disconnect from the tree & receiving & storing of nutrients from plant is stopped:

Allah The Almighty created such a plant, which on maturity produces such beautiful flowers; Males & Females. People glorify 'The Creater', to see such beautiful flowers & admire the beauty of flowers:

اَوَلَمْ يَرَوْا اِلَى الْاَرْضِ كَمْ اَنْۢبَتْنَا فِيْهَا مِنْ كُلِّ زَوْجٍ كَرِيْمٍ ۝ اِنَّ فِيْ ذٰلِكَ لَاٰيَةً ۝
(7,8 - الشعرآ- ۱۹)

Qoran emphasises that water is required to produce the beautiful flowers; males & females. When they bloom, the earth is decorated with their beauty:

وَاَنْزَلْنَا مِنَ السَّمَآءِ مَآءً فَاَنْۢبَتْنَا فِيْهَا مِنْ كُلِّ زَوْجٍ كَرِيْمٍ ۝ (21-لقمٰن-۱۰)

Verse Yousef indicates that at maturation, wheat plants bear cereals/*

Water is required during the growth, particularly at the phase of maturity, when plant/tree produces flowers of different colours & fruits of different tastes & colours:

اَلَمْ تَرَ اَنَّ اللّٰهَ اَنْزَلَ مِنَ السَّمَآءِ مَآءً ۚ فَاَخْرَجْنَا بِهٖ ثَمَرٰتٍ مُّخْتَلِفًا اَلْوَانُهَا ۝
(27-فاطر-22)

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*seeds, used as food: وَّسَبْعَ سُنْۢبُلٰتٍ خُضْرٍ ... ۝ (12- يوسف-۴۶)

Maturation ... contd...

Allah The Almighty alives earth by germinating seeds into seedlings, for which Allah The Almighty arranges most suitable source of water supply i.e. 'rain' from the sky. The Herbs, Shrubs and Trees grow out of these germinating seedlings and produce flowers & fruits/ cereals on maturity:

وَاٰيَةٌ لَّهُمُ الْاَرْضُ الْمَيْتَةُ ۚ اَحْيَيْنٰهَا وَاَخْرَجْنَا مِنْهَا حَبًّا فَمِنْهُ يَاْكُلُوْنَ ۝
وَجَعَلْنَا فِيْهَا جَنّٰتٍ مِّنْ نَّخِيْلٍ وَّاَعْنَابٍ وَّفَجَّرْنَا فِيْهَا مِنَ الْعُيُوْنِ ۙ
(33,34- يٰسٓ -23)

Glorify Allah The Almighty, Who created in pairs i.e. males & females of plants/trees grown by the earth:

سُبْحٰنَ الَّذِيْ خَلَقَ الْاَزْوَاجَ كُلَّهَا مِمَّا تُنْۢبِتُ الْاَرْضُ وَمِنْ اَنْفُسِهِمْ وَمِمَّا
لَا يَعْلَمُوْنَ ۝ (36 - يٰسٓ - 23)

Allah The Almighty created a varieties of vegetations, like; Herbs, Shrubs and Trees - which produce fruits/flowers & cereals of different tastes and colours, after attaining the stage of maturity during growth. For example, the farming of (wheat, rice & pulse) Olives, Pomogranates and Dates:

وَهُوَ الَّذِيْٓ اَنْشَاَ جَنّٰتٍ مَّعْرُوْشٰتٍ وَّغَيْرَ مَعْرُوْشٰتٍ وَّالنَّخْلَ
وَالزَّرْعَ مُخْتَلِفًا اُكُلُهٗ وَالزَّيْتُوْنَ وَالرُّمَّانَ مُتَشَابِهًا وَّغَيْرَ مُتَشَابِهٍ ؕ ۝
(141 - الانعام - 8)

When Allah The Almighty rains water from the sky, every things (living) that is created on earth; are created in pairs i.e. males and females, which is the sign of maturity:

وَاَنْزَلْنَا مِنَ السَّمَآءِ مَآءً فَاَنْۢبَتْنَا فِيْهَا مِنْ كُلِّ زَوْجٍ كَرِيْمٍ ۝ (21 - لقمٰن - ١٠)

Maturation ... contd...

Allah The Almighty specifies in Qoran that all types of fruits are created by the combination i.e. pollination & fertilization between male & female flowers:

وَمِنْ كُلِّ الثَّمَرٰتِ جَعَلَ فِيْهَا زَوْجَيْنِ اثْنَيْنِ ... ٥ (13-الرعد-3)

*كَمَثَلِ جَنَّةٍ بِرَبْوَةٍ اَصَابَهَا وَابِلٌ فَاٰتَتْ اُكُلَهَا ضِعْفَيْنِ ۚ فَاِنْ لَّمْ يُصِبْهَا وَابِلٌ فَطَلٌّ ۗ ٥ (3-البقرہ-265)

The above Qoranic Verse is purely scientific that fruit is the unified form of male & female flowers.

In the following Verse, Qoran informs that Herbs; which are small plants and some time creeps on the ground also produces male and female flowers on maturity. For that stage too, water is required, which Allah The Almighty rains from the sky:

وَاَنْزَلَ مِنَ السَّمَآءِ مَآءً ۚ فَاَخْرَجْنَا بِهٖٓ اَزْوَاجًا مِّنْ نَّبَاتٍ شَتّٰى ٥ كُلُوْا وَارْعَوْا اَنْعَامَكُمْ ۗ
اِنَّ فِيْ ذٰلِكَ لَاٰيٰتٍ لِّاُولِي النُّهٰى ۚ (16-طٰہٰ-53,54)

Allah The Almighty has created earth for the benefits of all the living creatures. The earth produces plants/trees. These plants/ trees produces flowers full of fragrance. The flowers ultimately produce variety of fruits like covered dates and cereals covered by husk:

وَالْاَرْضَ وَضَعَهَا لِلْاَنَامِ ۙ فِيْهَا فَاكِهَةٌ ۙ وَّالنَّخْلُ ذَاتُ الْاَكْمَامِ ۖ ٥ وَالْحَبُّ ذُو
الْعَصْفِ وَالرَّيْحَانُ ۚ (27-الرحمٰن-10-12)

Again, Qoran narrates that these flowers are of two types i.e. males and females, which unite to create the fruits. These are signs of maturity during the phases of growth:

فِيْهِمَا مِنْ كُلِّ فَاكِهَةٍ زَوْجٰنِ ۚ (الرحمٰن-52)

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*The Qoranic Verse indicates that growth of fruits depend on the sufficient supply of water.

Maturation ... contd...

Allah The Almighty rains pure water from the sky, which alives the dead earth i.e. hidden seeds beneath the earth, germinate, grow & ultimately mature enough to produce beautiful male & female flowers:

وَالَّذِيْ نَزَّلَ مِنَ السَّمَآءِ مَآءً بِقَدَرٍ ج فَاَنْشَرْنَا بِهٖ بَلْدَةً مَّيْتًا ج كَذٰلِكَ تُخْرَجُوْنَ ٥ وَالَّذِيْ خَلَقَ الْاَزْوَاجَ كُلَّهَا ... لا (25-الزخرف - ١١،١٢)

Allah The Almighty rains water from the sky, causes the germination of hidden seeds beneath the earth. These germinating seeds grow into a complete plants/trees and ultimately produce beautiful flowers and fruits, which humen & animals eat as their foods:

وَالْاَرْضَ مَدَدْنٰهَا وَاَلْقَيْنَا فِيْهَا رَوَاسِيَ وَاَنْۢبَتْنَا فِيْهَا مِنْ كُلِّ زَوْجٍۢ بَهِيْجٍ ج (26- ق -7)

اِنَّمَا مَثَلُ الْحَيٰوةِ الدُّنْيَا كَمَآءٍ اَنْزَلْنٰهُ مِنَ السَّمَآءِ فَاخْتَلَطَ بِهٖ نَبَاتُ الْاَرْضِ مِمَّا يَاْكُلُ النَّاسُ وَالْاَنْعَامُ ط حَتّٰٓى اِذَآ اَخَذَتِ الْاَرْضُ زُخْرُفَهَا وَازَّيَّنَتْ وَظَنَّ اَهْلُهَآ ... ٥ (١١- يونس -24)

The following Qoranic Episode of Hz Adam a.s. indicates that <u>tree</u> is source of i) Food*, ii) Clothes** & iii) Sexual Reproduction***:

هٰذِهِ الشَّجَرَةَ - ٥ فَلَمَّا ذَاقَا الشَّجَرَةَ بَدَتْ لَهُمَا سَوْاٰتُهُمَا وَطَفِقَا يَخْصِفٰنِ عَلَيْهِمَا مِنْ وَّرَقِ الْجَنَّةِ ط وَنَادٰىهُمَا رَبُّهُمَآ اَلَمْ اَنْهَكُمَا عَنْ تِلْكُمَا الشَّجَرَةِ - ٥ (18- الاعراف - ٢٢ و ٢٠)

Therefore, on maturation, plants & trees not only supply us our food, but all sorts of basic needs, required for our life.

The next sub chapter iii, contains the scientific details regarding the stage of maturation during growth.

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*Fruits/cereals are obtained from tree/plant.

**Cotton, Silk & Jute are obtained from tree.

***Tree produces food, food is converted to blood when eaten and blood vitalises the sexual organs.

sub chapter iii

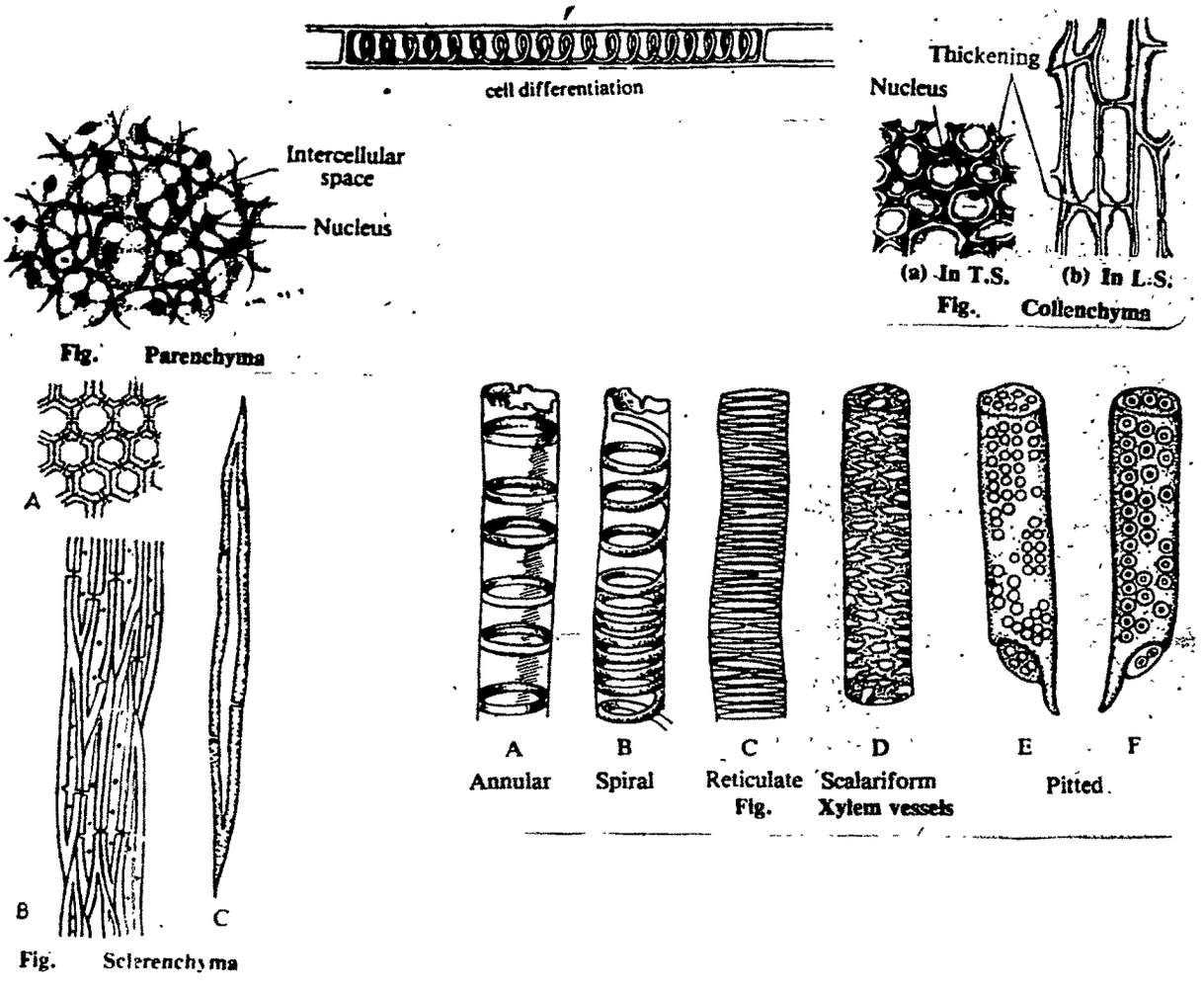
MATURATION: ... contd...

Let me review the scientific aspects regarding the 'Maturation' of the plants.

I have already discussed the phases of growth in the previous chapter, particularly the cell division and cell elongation. The last phase of the growth is cell maturation or cell differentiation.

CELL MATURATION/CELL DIFFERENTIATION:

The elongated cells undergo the structural and chemical changes, and finally differentiate into permanent cells, which form different tissues life; Parenchyma, Collenchyma, Sclerenchyma, Xylem & Phloem:



Maturation ... contd...

At this phase of growth, the whole plant is differentiated into Root & Shoot. Root is more or less same; bearing primary, secondary and some times tertiary roots, root hairs and root apex. While shoot is differentiated into stem, branches, leaves, flowers and fruits under two types of growth; i) Vegetative Growth & ii) Reproductive Growth.

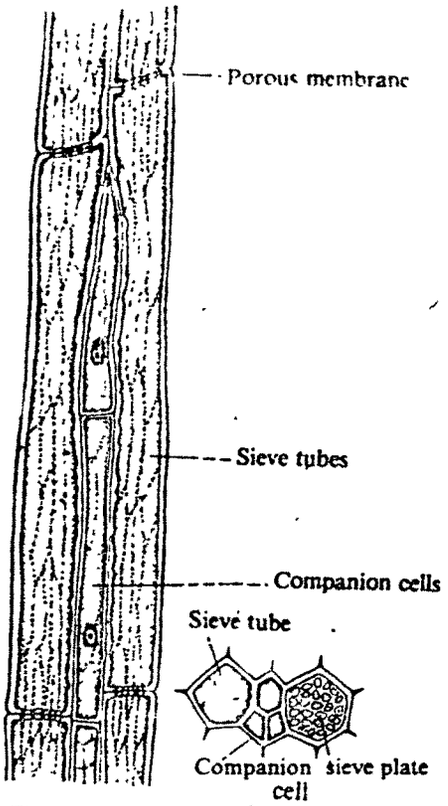


Fig. . Phloem vessels L.S. , T.S.

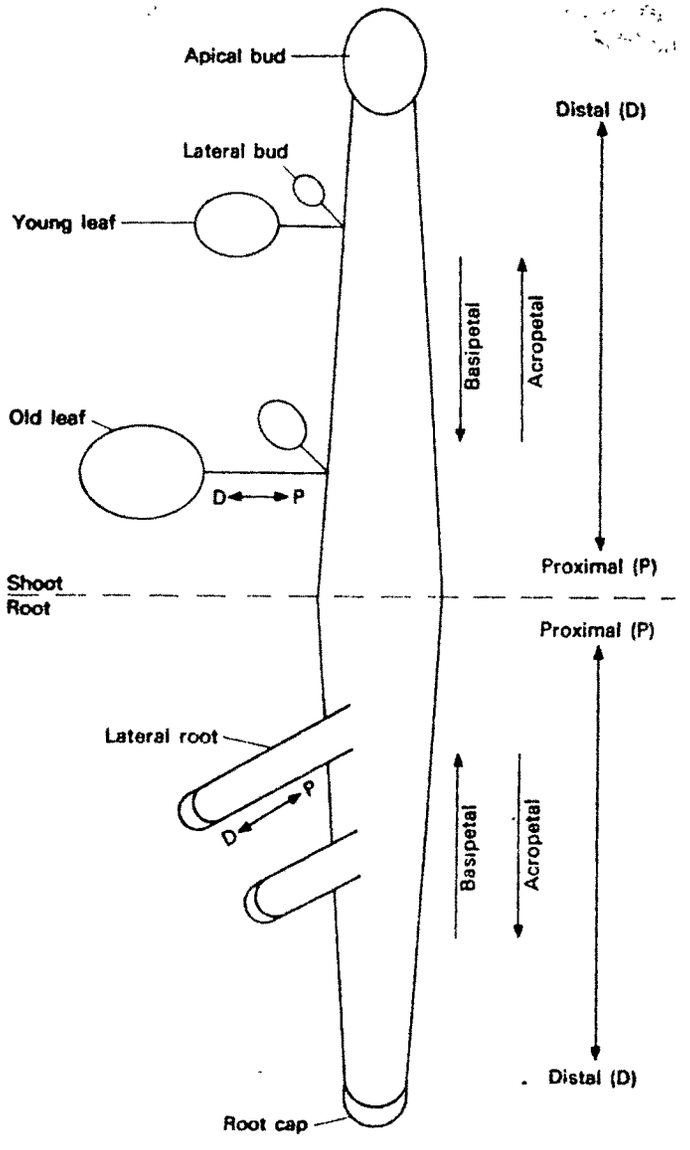


Figure -: Topography of the shoot and root of a plant, illustrating the use of the terms "distal" (away from the main body of the plant) and "proximal" (toward the main body), as well as basipetal and acropetal.

Maturation ... contd...

a) **Vegetative Growth:** Vegetative growth the following:

1) Cellular Differentiation
2) Organization of the Tissues
3) Development of the organs.

1) Cellular Differentiation & 2) Organization of Tissues are discussed earlier, now, I take-up:

3) Development of the Organs: Organs or the body parts of the plar like root, stem, branches and leaves are the vegetative parts of the plants. I take a brief growth of each part one by one.

a) initiation of Lateral Roots & Buds*: Lateral Root Primordia aris in the 'pericycle' at positions related to the Primary Xylem. Initiation takes place at a level where Cell Differentiation is proceeding in Primary Root Tissue. there is also evidence, that the shoot sytem influences 'Root Branching'. It has been postulated that both lateral Root and Adventitious Root development is controlled by substances like Rhizocalines a kind of 'Auxin', synthesised in Shoot.

Prior to the formation of Root & Shoot, Primordia is a 'Callus Tissue' - there can be distinguished group of lightly packed 'Meristematic Cells' charecterised by their small size, dense 'Cytoplasm' and prominent 'Nuclie'. The group is called 'Meristomoids'.

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*The Qoranic verse inidicates the existence of buds and that buds are points of vegetative & reproductive growth:

وَزُرُوعٍ وَنَخْلٍ طَلْعُهَا هَضِيمٌ ۝ (۱۹ - الشعراء - 148)

Maturation ... Vegetative Growth ... contd...

b) Leaf Initiation & Growth: Leaves are arranged on the shoot in a regular manner as a consequence of spatial i.e. space regularity with which Primordia arise at the Shoot Apex.

The development of leaves involves the functioning in sequence and for a limited time of a number of zones of Meristematic activity and an associated programme of Cell Expansion and Differentiation.

c) Apical Dominance: Apical Dominance is the phenomenon of suppresion of Lateral Root emergence or Lateral Bud outgrowth by an actively growing main Root or main Shoot Apex.

An actively growing main Shoot Apex inhibits the growth of Lateral Buds nearest to the Apex and the distance over which the suppression operates, is a measure of intensity of 'Apical Dominance'.

Cytokinin, apparently essential to Bud growth, is synthesised in the 'Root' and transported to the 'Shoot'.

d) Seasonal Bud Dormancy: Dormancy is defined as the lack of growth in potentially growing system. If the dormancy results from unfavourable external conditions e.g. low temprature or lack of water, growth may resumed as soon as the unfavourable conditions are over.

William P. Jacob adds that certain Hormones are necessary for the Plants development.

Maturation . . . Vegetative Growth ... contd...

Hormones for Vegetative Growth:

a) Root & Hormones: 'Auxin' moving from the Root Tip towards the Root Base, is partially diverted due to the 'Gravity' to the lower side of the Root, causing greater inhibition of Root Elong ation and shows positive Geotropic Curvature.

Another hormone `Cytokinins´. 6 Benzyle Amino Purine is a synthe tic Cytokinins. This hormone is responsible for good growth proliferation of cells. Cytokinins is synthesised in Root. 4 Hyd roxy 3 Mehtyl but 2 Enyle Amino Purine or Zeatin is a natural Cytokinins.

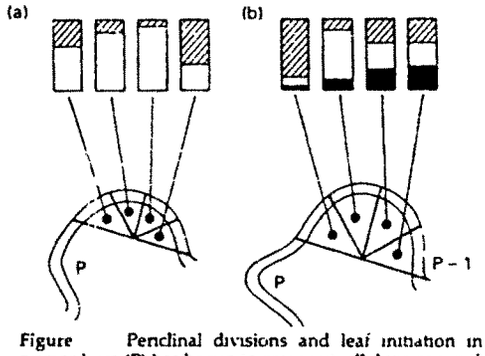
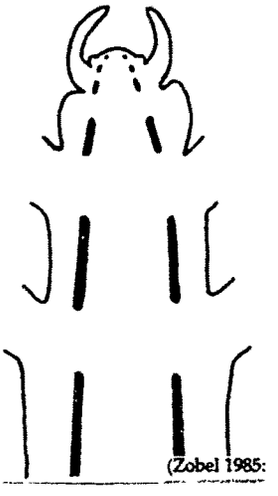


Figure Penclinal divisions and leaf initiation in pea (a) Just after a new leaf primordium (P) has begun to grow out, all divisions in the apical dome are anticlinal in the plane of the section (□) or perpendicular to it (▨). (b) About 16 h before the next primordium is formed at P-1, penclinal divisions (■) appear The divisions in the three planes are in the ratio 1:1:1, indicating no preferred division plane The restriction on penclinal division in (a) has been lifted in (b) (Lyndon 1983)


(Zobel 1985:

b] Shoot and Hormones `Auxin´ or IAA i.e. Indole Acetic Acid causes the shoot elongation and regeneration of shoot cutting. Auxin was discovered by Charles Darwin. Auxin is mainly found in human urine. Auxins are mainly responsible for elongation of shoots, barks, branches and proliferation of cells.

`Gibberellins or Gibberellic Acid´ is another hormone responsible for abnormal elongation of the young plants stems. Vegetative parts of the plants contain lesser contents of Gibberellins, than the Reproductive Parts of the plants. Gibberellins are found in plant extract.

Maturation... Hormones ...contd...

c) Leaves & Hormones: The development of young leaves bases on the important hormone Auxin or IAA. Distal leaves are solely responsible for the production of Auxin hormones.

Although Auxin is produced within the blade of young leaves, it has undetectable effect on the growth of the leaf-blade. Auxin also controls the growth of stem, coleoptiles, petioles and to the some the growth of fruits.

b) Reproductive Growth: Reproductive growth of the plant covers the following points:

1) Flowering
2) Fruit Development

Although plant development is a continuous process, there can occur sharp qualitative changes, such as Transition from Vegetative Development to Reproductive Development. Simillarly, in some plants, there occurs a transition from a 'Juvenile' to an 'adult' form. Only Adult form is capable of flowering.

1) Flowering: The development of flowers require:
   -Differentiation of the Embryonic Flower buds, active cell division at required temprature i.e. 20 °C.
   -An apparent rest of about 13 weeks at required optimum temprature i.e. 8 to 9 °C.
   -Nine weeks period of rapid growth of 'Floral Organs' and elongation of flower stalk. Optimum temprature is about 13 to 15 °C.

In case of 'Uni-sexual', 'Auxin' promotes the Female flowering

Maturation ... Flowering ... contd...

while Gibberellic Acid promotes the Male flowering.

Parts of Flower:

There are following parts in a flower:

a) Accessory Reproductive parts in the flower:

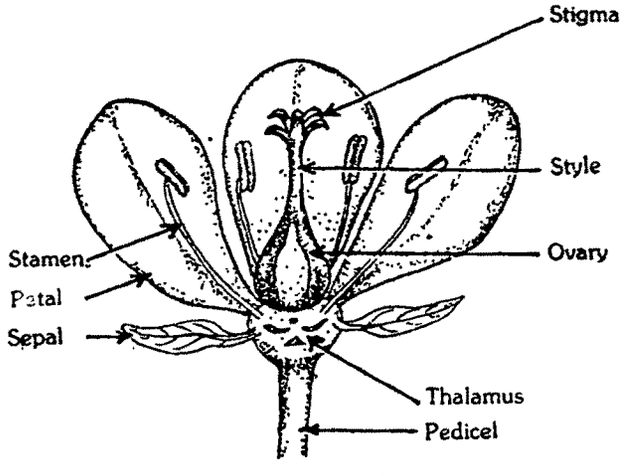
1) Calyx & 2) Corolla

b) Necessary Reproductive parts in the flower:

3) Androecium & 4) Gynoecium

Calyx: Calyx is a group of 'sepals' in the form of outer-most green 'whorl'. Calyx protects three inner whorls in flowers, during 'Bud' stage and remains even in ripe fruits in the form of 'Circular Disc'.

Corolla: Corolla is a group of coloured 'Petals', arranged in a 'whorl'. Corolla on one hand protects the two inner whorl, and beautifies the flowers on the other hand.

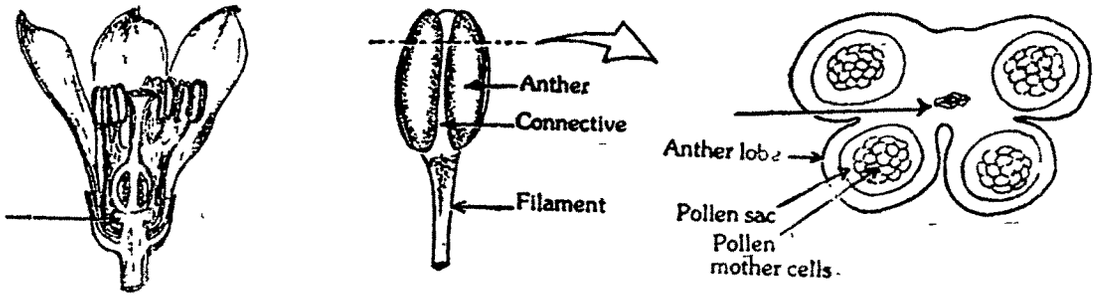


وَالْحَبُّ ذُو الْعَصْفِ وَالرَّيْحَانُ ۝ (55-الرحمٰن-12)

فِيهِمَا مِن كُلِّ فَاكِهَةٍ زَوْجَانِ ۝ (55-الرحمٰن-52)

Maturation ... flowering ... contd...

Androecium: Androecium is male reproductive part in flower. It contains a group of stamens. Stamens are divided into Anther & Filament. Anther contains Pollen Sac. Hundreds of Pollen Grains are found in each Pollen Sac. At Maturity Pollen Grains are scattered in air.



The above figures show; i) Androecium containing group of stamen, ii) Single stamen & iii) Section through Pollen Sac.

STRUCTURE OF POLLEN GRAINS/MICROSPORES: Pollen Grains are oval or circular in shape. Each pollen grain has two cells, one nuclus & two coverings; i) Exine: outer & thick and ii) Intine: inner & thin.

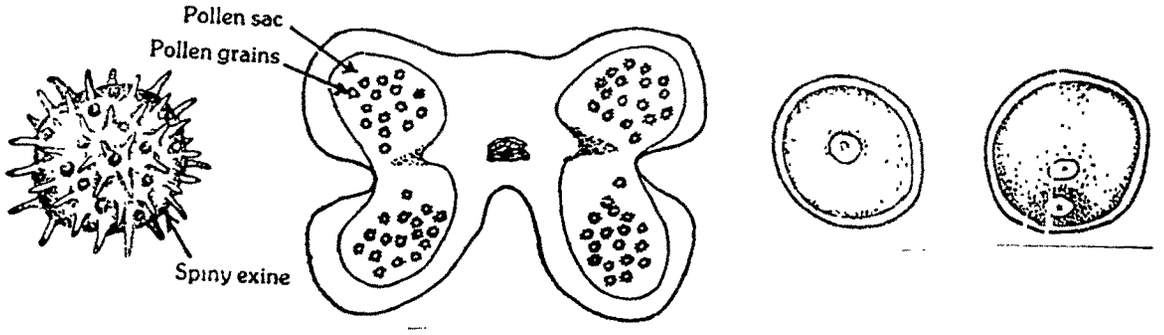
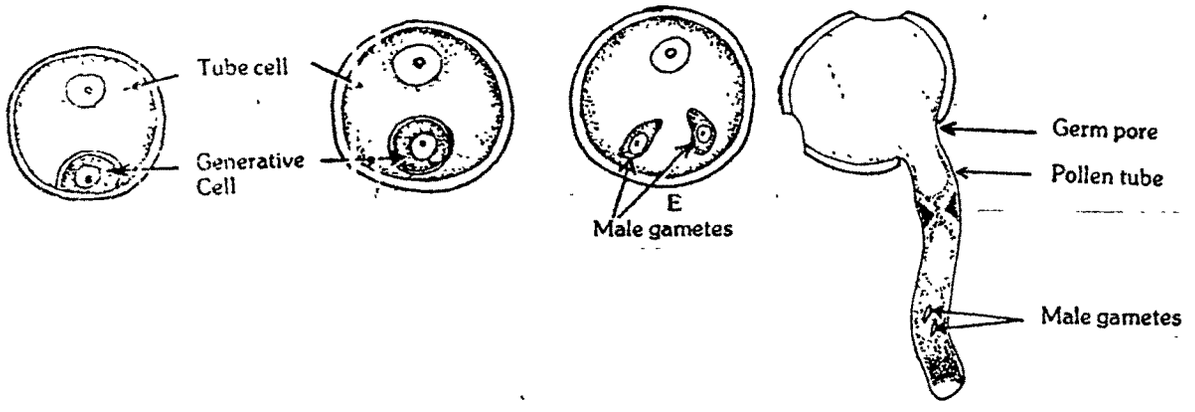


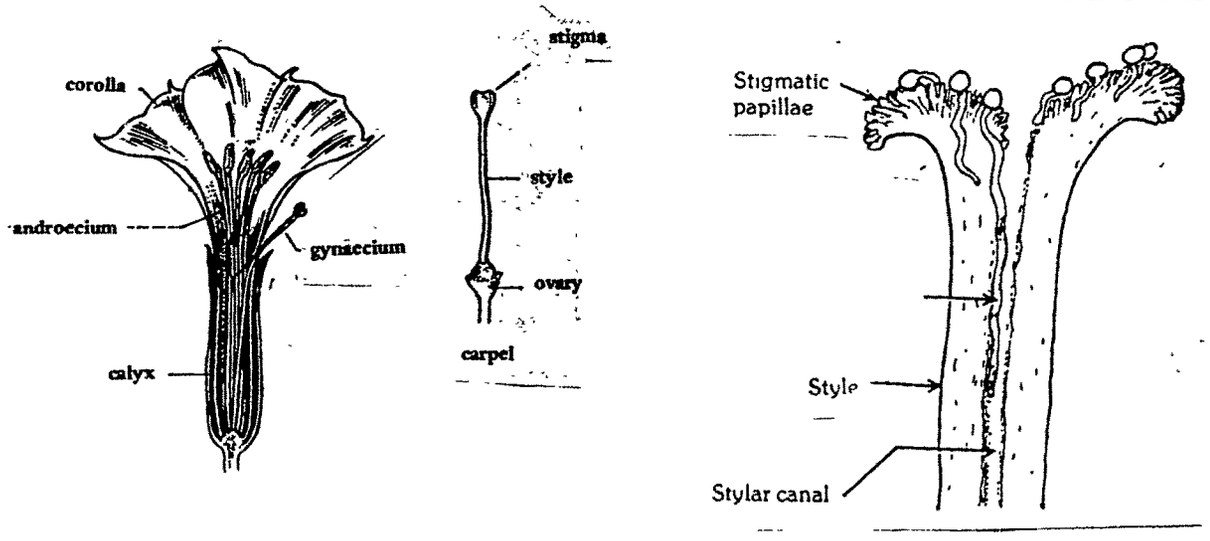
Figure showing Pollen Sac & Pollen Grain; external & internal.

Maturation ... Flowering ... contd...

Each Microspore bear three unicellular 'germ pores'. One of them constitue 'tube cell', while other two constitute 'generative cell', and are called as 'Male Gametophyte'. Pollination takes place when pollen grains become two celled.



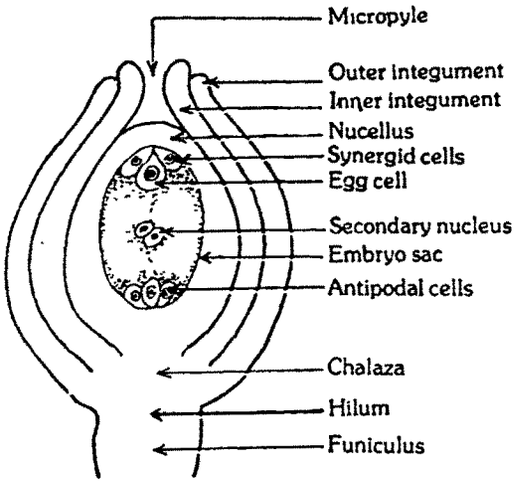
Gynoecium: Gynoecium is female reproductive part of the flower. Gynoecium is group of 'Carpels' and situated centrall. Each carpel is divided into 'ovary' the basal part, and 'Stigma' the upper part. Ovar & Stigma are connected with a filament; called Style. In ovary, ovule is found attached to the Placenta on the central axis. Each ovule consist of a central mass called 'Nucellus'



Flowering ... contd...

STRUCTURE OF OVULE:

Nucellus; the central mass of cells of ovule is bounded by a distinct 'Epidermis' and is covered with sinle coat, called 'Integument'. Integument does not cover the Nucellus completely, but leaves an opening space called 'Micropyle'.

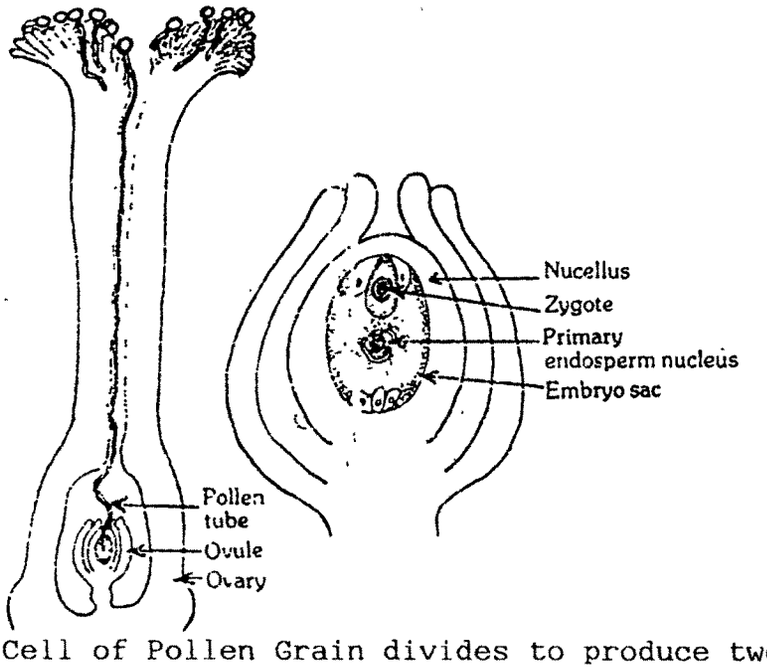


The cells of the Ovule are diploid i.e. bearing 2X chromosomes. Only one cell of the Nucellus undergoes Reduction Division and '4' haploid i.e. bearing 'X' chromosomes, Megaspores are produced. Three of them degenerate and one Megaspore develops into a Female Gametophyte or 'Embryo Sac'. Egg & Secondary Nucellus are the main constituents of the Embryo Sac.

Pollination: Transfer of Pollen Grains from one flower to another flower is called as "Pollination". The means of transfer of pollen grains during 'pollination' are; i) Air, ii) Insects or iii) Water etc.

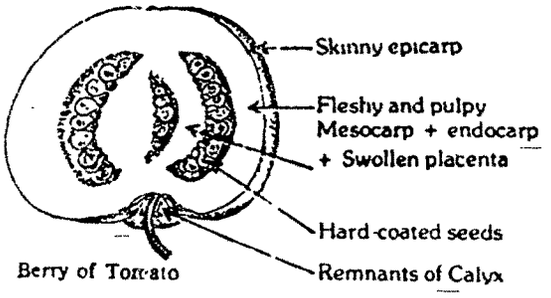
Flowering ... contd...

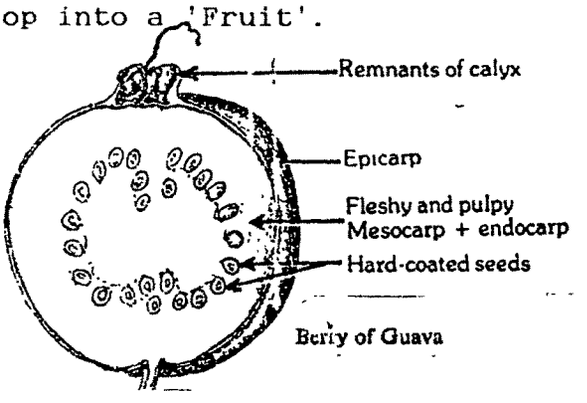
Ferilization: The two celled Pollen Grains i.e. Male Gametophyte reaches to Stigma during Pollination, where it germinate into a long 'Pollen Tube'. The Pollen Tube elongates and ultimately enters into Embryo Sac, after passing through Style & Micropyle.



The Generative Cell of Pollen Grain divides to produce two Male Gametes. One Male Gamete 'X' unites with the Female Egg 'X' to form a Zygote '2X' and other Male Gamete unites with the 2ndary Nucellus to form the Primary Endsperm Nucleus, which later changes to 'Endosperm'.

Fruit Development: The Zygote develops into an 'Embryo'. The Ovule develops into seed and Integument of Ovule becomes Seed Coat and Ovary Develop into a 'Fruit'.





Flowering ... contd...

Hormones for Reproductive Growth:

a) Flowering & Hormones: Flowers are efficient devices for ensuring Sexual Reproduction. Flowers are developed from the Apical Meristem of shoot. Shoot Meristem is also responsible to produce leaves. Hormones are produced within the leaves and then transported to Meristem and consumed for producing flowers. The Hormones control and stop the production of leaves while producing the flowers.

'Gibberellins' is the main hormone utilized during the production of flowers, specially the Male Flowers, while 'Auxin' is utilized during the production of Female Flowers.

b) Fruit Development & Hormones: Auxin & Gibberellins are the main hormones help in the production of fruits. Germinating Pollen Grains are the rich source of Auxin, synthesised by the tissues of Gynoecium.

Maturity of plants/trees, sooner or later followed by 'Ageing' or 'Senescene' and ultimately death. Senescene is a complex 'Catabolic' events, which, if does not reverse, leads to the death of Cells, Organs and Organisms.

sub chapter iv

Dehydration & Death:

Allah The Almighty alives the dead earth when the rain falls. The rainy water germinates the hidden seeds beneath the earth, thus, seed changes to 'seed lings'. Later, under the favourable conditions, the seed-lings keep on growing till change to full-fledged mature plants. A stage arrives, when the 'base of life' i.e. water abondons the body of plant, causing 'dehydration'. The dehydration leads to death.

The Qoran reveal the 'dehydration', alarming the death of the plants Due to the dehydration the green colour of the plants also change to 'yellowish':

كَمَثَلِ غَيْثٍ اَعْجَبَ الْكُفَّارَ نَبَاتُهٗ ثُمَّ يَهِيْجُ فَتَرٰهُ مُصْفَرًّا ثُمَّ يَكُوْنُ حُطَامًا ... ۝ (57 - الحديد - 20)

اَلَمْ تَرَ اَنَّ اللّٰهَ اَنْزَلَ مِنَ السَّمَآءِ مَآءً فَسَلَكَهٗ يَنَابِيْعَ فِى الْاَرْضِ ثُمَّ يُخْرِجُ بِهٖ زَرْعًا مُّخْتَلِفًا اَلْوَانُهٗ ثُمَّ يَهِيْجُ فَتَرٰهُ مُصْفَرًّا ثُمَّ يَجْعَلُهٗ حُطَامًا ؕ اِنَّ فِىْ ذٰلِكَ لَذِكْرٰى لِاُولِى الْاَلْبَابِ ۝ (39 - الزمر - 21)

وَّسَبْعِ سُنْۢبُلٰتٍ خُضْرٍ وَّاُخَرَ يٰبِسٰتٍ* ... ۝ (12 - يوسف - 46)

The Qoran illustrates the phenomenon of 'dehydration'; the way Allah The Almighty blows the 'air', which lifts the water vapour into the sky and cloud is developed. In the same way Allah The Alimghty blows the 'air', which causes the dehydration and green plants turn to yellow:

وَلَئِنْ اَرْسَلْنَا رِيْحًا فَرَاَوْهُ مُصْفَرًّا ... ۝ (30 - الروم - 51)

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*dried or dehydrated seeds.

Dehydration ... contd...

Allah The Almighty blows 'air', which causes very high rate of transpiration, with the result that the water of the plant body vapours out causing 'dehydration', which leads to the death of the plant. This is an example of living creatures in this world, that rainy water alives the eartn where plants grow & produce food for other living creature and ultimately die. In the same way life cycles in others living creature, particularly human:

وَاضْرِبْ لَهُمْ مَّثَلَ الْحَيٰوةِ الدُّنْيَا كَمَآءٍ اَنْزَلْنٰهُ مِنَ السَّمَآءِ فَاخْتَلَطَ بِهٖ نَبَاتُ الْاَرْضِ فَاَصْبَحَ هَشِيْمًا تَذْرُوْهُ الرِّيٰحُ ۭ وَكَانَ اللّٰهُ عَلٰي كُلِّ شَيْءٍ مُّقْتَدِرًا ۝ (١٥- الكهف-45)

اِنَّآ اَرْسَلْنَا عَلَيْهِمْ صَيْحَةً وَّاحِدَةً فَكَانُوْا كَهَشِيْمِ الْمُحْتَظِرِ ۝ (27-القمر-31)

Again, Allah The Almighy describes in Qoran that life cycles of other living creatures on earth are just like the life cycle of plants. Allah The Almighty rains water from the sky, which causes germination of the hidden seeds beneath the dead earth. This dead seed germintes to seed-ling, and continues to grow into plant, bearing stem, root, branches & leaves. And ultimately matures enough to produce beautiful flowers fruits, increasing the beauty of earth. The cultivator becomes very happy to see his beautiful 'farm', but Allah The Almighty may cause the instant death to all these plants/trees:

اِنَّمَا مَثَلُ الْحَيٰوةِ الدُّنْيَا كَمَآءٍ اَنْزَلْنٰهُ مِنَ السَّمَآءِ فَاخْتَلَطَ بِهٖ نَبَاتُ الْاَرْضِ مِمَّا يَاْكُلُ النَّاسُ وَالْاَنْعَامُ ۭ حَتّٰٓى اِذَآ اَخَذَتِ الْاَرْضُ زُخْرُفَهَا وَازَّيَّنَتْ وَظَنَّ اَهْلُهَآ اَنَّهُمْ قٰدِرُوْنَ عَلَيْهَآ ۙ اَتٰىهَآ اَمْرُنَا لَيْلًا اَوْ نَهَارًا فَجَعَلْنٰهَا حَصِيْدًا كَاَنْ لَّمْ تَغْنَ بِالْاَمْسِ ۭ ... ۝ (١١- يونس-24)

Dehydration ... contd...

Allah The Almighy compels the cultivators to ponder over that it is he (the cultivator) or Allah The Almighty, who causes germination and complete growth of plants/trees till they produce flowers and fruits to benefit the rest living creature? The cultivator thinks over and says, yes, the real creator is Almighty Allah. Allah The Almighty turn these green plants/trees ladden with flowers & fruits into yellow dry tissues, when He wishes:

أَفَرَءَيْتُم مَّا تَحْرُثُونَ ۝ ءَأَنتُمْ تَزْرَعُونَهُۥٓ أَمْ نَحْنُ ٱلزَّٰرِعُونَ ۝ لَوْ نَشَآءُ لَجَعَلْنَٰهُ حُطَٰمًا فَظَلْتُمْ تَفَكَّهُونَ ۝ (56-الواقعة-63-65)

Allah The Almighty, Who creates greenery/pastures from earth, then they get dry* and ultimately turn black i.e. in other words they die:

وَٱلَّذِىٓ أَخْرَجَ ٱلْمَرْعَىٰ ۝ فَجَعَلَهُۥ غُثَآءً أَحْوَىٰ ۝ (87-الاعلى-4,5)

Blackness indicates that the main constituents of a plant is Carbon.

Allah The Almighty declares in Qoran that every thing that grows on earth has to die:

كُلُّ مَنْ عَلَيْهَا فَانٍ ۝ (55-الرحمن-26)

The big trees which have usually long span of life, show the fall of dehydrated/dried leaves annually. This fall indicates the death & termination of functions of the leaf and new leaves develop to own the responsibilities of photosynthesis/respiration/transpiration etc.

وَيَعْلَمُ مَا فِى ٱلْبَرِّ وَٱلْبَحْرِ ۚ وَمَا تَسْقُطُ مِن وَرَقَةٍ إِلَّا يَعْلَمُهَا وَلَا حَبَّةٍ فِى ظُلُمَٰتِ ٱلْأَرْضِ وَلَا رَطْبٍ وَلَا يَابِسٍ إِلَّا فِى كِتَٰبٍ مُّبِينٍ ۝ (6-الأنعام-59)

*The rate of transpiration is very high, while rate of translocation of water & minerals is almost nil.

sub chapter iv

Dehydration & Death: contd....

Now, let me review the scientific aspects regarding dehydration and death of plants.

Maturity is sooner or later followed by 'Ageing' or 'Senescene' and death. Senescene is a complex 'catabolic' events, which, if does not reverse to 'Anabolism'*, leads to death of Cells, Organs and Organisms.

After maturation, fruits, seeds & cereals are consumed by humen & animals as their food. Therefore, the next chapter III is based on Qoranic and scientific details regarding food.

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*is a type of metabolic activity that help in growth, while catabolic activity destroys the growth.