**Dr. Rima Kumari: Date: 13/08/2020**

Online class and e- content for Bsc IIIrd Year students

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| Date and Time | Online class medium  | E. content topic |
| 13/08/202001:20 p.m to 2.05 p.m | Via Google meetLink: Meeting URL: https://meet.google.com/mjz-tbco-mma | **Abscisic acid** **and Ethylene**  |

**Abscisic acid**:

It is also called stress hormone because the produc­tion of hormone is stimulated under stressful environmental conditions, such as drought, water logging dehydration, cold temperatures, or shortened day lengths. Its activity counters many of the growth-promoting effects of GAs and auxins. ABA inhibits stem elongation and induces dormancy in lateral buds.

Abscisic acid is known as dormin as it induces dormancy in buds, underground stems and seeds. It functions in many plant developmental processes, including bud dormancy, inhibition of seed germination, and plant stress tolerance. ABA induces dormancy in seeds by blocking germination and promoting the synthesis of storage proteins. Plants adapted to temperate climates require a long period of cold temperature before seeds germinate. This mechanism protects young plants from sprouting too early during unseasonably warm weather in winter. As the hormone gradually breaks down over winter, the seed is released from dormancy and germinates when conditions are favorable in spring. Another effect of ABA is to promote the development of winter buds; it mediates the conversion of the apical meristem into a dormant bud. Low soil moisture causes an increase in ABA, which causes stomata to close, reducing water loss in winter buds.

The hormone was first isolated by Addicott (1963) from Cotton bolls. It is produced in many parts of the plants but more abundantly inside the chloroplasts of green cells. The hormone is formed from mevalonic acid or xanthophyll. It is transported to all parts of the plant through diffusion as well as transport channels (phloem and xylem). Its other names are abscissin II and inhibitor-B. Abscisic acid is a mildly acidic dextrorotatory cis sesquiterpene growth hormone which functions as a general growth inhibitor by counteracting other hormones (auxin, gibberellins, and cytokinins) or reactions mediated by them.

#### Functions of Abscisic Acid:

**1. Bud Dormancy:**

Abscisic acid induces dormancy of buds towards the approach of winter.

**2. Seed Dormancy:**

It is mainly caused by abscisic acid. Dormancy allows seeds to tolerate desiccation and extremes of temperature better. The buds as well as seeds sprout only when abscisic acid is overcome by gibberellins. Because of its action in inducing dormancy, abscisic acid or ABA is also named as dormin.

**3. Stoppage of Cambium Activity:**

Formation of abscisic acid stops mitosis in vascu­lar cambium towards the approach of winter.

**4. Abscission:**

Abscisic acid promotes abscission of flowers and fruits.

**5. Leaf Senescence:**

Its excessive presence stops protein and RNA synthesis in the leaves and hence stimulates their senescence (leaf fall is actually promoted by ethylene).

**6. Transpiration:**

During desiccation and other stresses, abscisic acid is rapidly synthesised. The inhibitor causes closure of stomata and hence prevents transpiration.

**7. Resistance:**

Abscisic acid increases resistance of plants to cold and other types of stresses. It is, therefore, also known as stress hormone.

**8. Starch Hydrolysis:**

Abscisic acid inhibits gibberellin mediated amylase formation during germination of cereal grains.

**9. Flowering:**

In small quantities, abscisic acid is known to promote flowering in some short day plants, e.g., Strawberry, Black Currant.

**10. Parthenocarpy:**

ABA has been found to induce parthenocarpic development in Rose.

**11. Rooting:**

Rooting of stem cuttings is promoted in some cases by abscisic acid, e.g., Bean, Ivy, Poinsettia (= Euphorbia pulcherrima).

**12. Membrane Potential:**

ABA induces a positive surface potential on cell membrane.

**13. Controlled Growth:**

It is antagonist to gibberellins and counteracts the effect of other growth promoting hormones (auxins and cytokinins) and therefore, keeps their activity under check. By controlling growth, ABA plays an important role in seed development and seed maturation. Normally it inhibits seed germination, growth of excised embryos, growth of Duckweed and other plants.

#### Uses of Abscisic Acid:

**1. Antitranspirant:**

Application of minute quantity of abscisic acid to leaves shall reduce transpiration to a great extent through partial closure of stomata. It conserves water and reduces the requirement of irrigation. Photosynthesis is reduced to a lesser extent (Transpiration 56%: Photosynthesis 14%).

**2. Flowering:**

It is useful in introducing flowering in some short day plants kept under un-favourable photoperiods.

**3. Rooting:**

Use of abscisic acid promotes rooting in many stem cuttings.

**4. Dormancy:**

Abscisic acid can be used in prolonging dormancy of buds, storage organs and seeds.

**Ethylene**

Ethylene as a plant hormone, acts at trace levels throughout the life of the plant by stimulating or regulating the ripening of fruit, the opening of flowers, the abscission (or shedding) of leaves and, in aquatic and semi-aquatic species, promoting the 'escape' from submergence by means of rapid elongation of stems or leaves. Ethylene is associated with fruit ripening, flower wilting, and leaf fall. Ethylene is a small hydrocarbon, the colourless flammable gas which is denoted by a formula C2H4 or H2C=CH2. Ethene is the IUPAC name for ethylene. It has a “sweet and musky” odour when it is pure. It is the simplest alkene and also the second simplest unsaturated hydrocarbon C2H2. Ethylene is biosynthesized from the amino acid methionine. Aging tissues (especially senescing leaves) and nodes of stems produce ethylene. The best-known effect of the hormone, however, is the promotion of fruit ripening. ethylene is also used in agricultural practices to ripen fruits, Ethylene stimulates the conversion of starch and acids to sugars. Some people store unripe fruit, such as avocados, in a sealed paper bag to accelerate ripening; the gas released by the first fruit to mature will speed up the maturation of the remaining fruit. Ethylene also triggers leaf and fruit abscission, flower fading and dropping, and promotes germination in some cereals and sprouting of bulbs and potatoes. Ethylene is widely used in agriculture. Commercial fruit growers control the timing of fruit ripening with application of the gas. Horticulturalists inhibit leaf dropping in ornamental plants by removing ethylene from greenhouses using fans and ventilation.

Physiological role of Ethylene

Ethylene is the most widely used [plant growth regulator](https://byjus.com/biology/plant-growth-regulators/) as it plays a vital role in:

* Stimulating fruit ripening.
* Helps in determining the sex of a flower.
* It is involved in the production of female flowers in a male plant.
* Promotes Apo-geotropism in roots.
* Helps in the root initiation and pollination.
* Ethylene increases the speed of leaf and flower senescence**.**
* Induces seed germination.
* Induces root growth to increase the capability of water and mineral absorption.
* Stimulates epinasty.
* Induces a climacteric rise in respiration in some fruits.
* Effects gravitropism.
* Stimulates nutational bending.
* Inhibits stem growth.
* Interference with auxin transport.
* Induces flowering in pineapples.

**Main Functions of Ethylene:**

**Promote abscission:**

Ethylene stimulates abscission of leaves, fruits and flowers. It has been shown by Rasmusson and his associates that the action of ethylene is mediated through the enhancement of acid phosphatase and other hydrolases.

**Promote senescence:**

Ethylene induces yellowing of leaves and downward bending. The flowers may even fade in its presence and wither. Presence of ethylene induces colour changes in flowers.

**Ageotropic Movements:**

Ethylene makes the stems ageotropic possibly by inhibiting polar transport of auxin. However, ethylene is essentially required for geotropic response of stem.

**Inhibitory effect on Growth:**

In general ethylene has inhibitory effect and retards longitudinal growth. On the other hand it promotes isodiametric and transverse growth. It promotes pollen tube growth.

**Breaking of Dormancy:**

Ethylene can break dormancy of several plant organs but inhibits lateral bud growth.

**Induce rooting:**

In Phaseolns, rooting of cuttings is enhanced through ethylene application.

**Flowering:**

Ethylene induces flowering in pineapple.

**Fruit Ripening:**

The primary role of ethylene seems to be in fruit ripening. The process is well marked in climacteric fruits. The fruit dehiscence may also be affected by ethylene. It also affects peroxidase levels.

The role of ethylene in affecting polar transport of auxin has also been proposed by some workers. The role of ethylene producing compounds on sex reversion and formation of female flowers has also been demonstrated in Cannabis and papaya.