

ETHYLENE

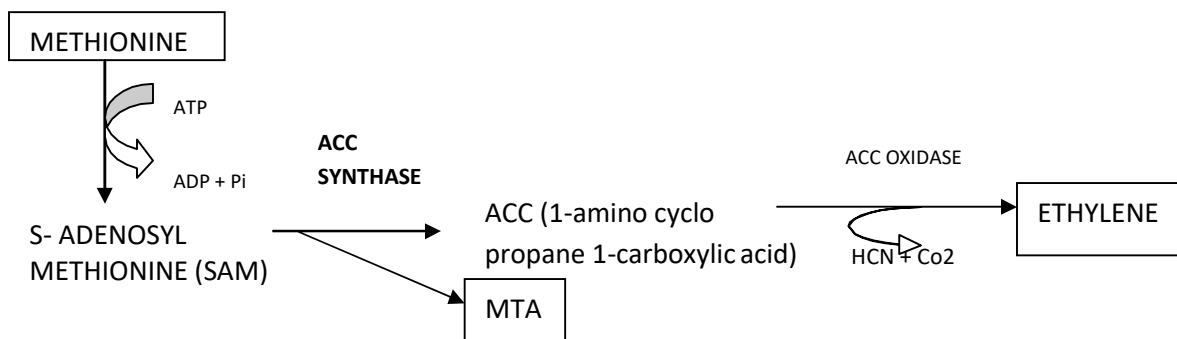
Neljubow (1901) a Russian plant physiologist was the first to show the importance of ethylene present in the illuminating gas as a growth regulator of plants. He observed that dark grown pea seed lings growing in the laboratory (illuminated with coal gas) exhibited symptoms that were later termed as *triple response*: reduced stem elongation, increased lateral growth, and abnormal horizontal growth. Denny (1924), reported that ethylene is highly effective in inducing fruit ripening. **Gane** (1934) established that ethylene is produced by the apple fruits during ripening in storage.

28.1 Occurrence

In higher plants, all most the parts of the plant body produce ethylene. In general meristematic regions and nodal regions are most active in ethylene biosynthesis. However, ethylene production also increases during leaf abscission and flower senescence, as well as during fruit ripening. This is otherwise called as phytoogerontological hormone .

28.2 Bio-synthesis

The amino acid Methionine is the precursor of ethylene, and ACC (1-amino cyclo propane 1-carboxylic acid) serves as an intermediate in the conversion of methionine to ethylene. Methionine activated by ATP gives rise to S-adenosyl Methionine (SAM). This reaction is mediated by enzyme Methionione adenosyl transferase. In the next step, SAM breaks into 5'-methyl thio adenosine (MTA) and amino cyclo propane carboxylic acid (ACC). This reaction is carried by the enzyme ACC synthase. ACC is oxidized to ethylene with the release of HCN (Hydrogen cyanide) and Co₂.



Amino ethoxy vinyl glycine (AVG), and Amino oxy acetic acid (AOA) block the conversion of SAM to ACC. Silver Nitrate and Silver thio sulphate are the specific inhibitors of ethylene action.

Ethylene Transport

Ethylene being a gas can easily diffuse into plant tissues through the intercellular spaces. From ripening fruits, ethylene diffuses out into the atmosphere through the cut end of pedicel and fruit surface.

28.3 MODE OF ACTION:

There are several theories to explain the mechanism of action of ethylene.

Membrane permeability

Ethylene is considered to dissolve in cell membranes altering their permeability. Ethylene is highly soluble in lipids which are constituents of cell membranes.

Another hypothesis is by regulating auxin metabolism. Ethylene treatment results in a reduction in the content of diffusible (free) auxin. This may result from (1) decreased synthesis (2) decreased transport and (3) increased binding. Ethylene has been shown to inhibit transport of auxin from the site of production to the site of action.

28.4 PHYSIOLOGICAL ROLES (Includes both positive and negative effects)

A. Fruit ripening

Broadly fruits can be classified into two types on the basis of their respiratory pattern during ripening. In some fruits like apple and banana as the fruit matures and attains its maximum size, the rate of respiration decreases and becomes very low. After the fruit is harvested and stored for ripening, there is a great increase in the rate of respiration and the rise continues till it attains a sharp peak. This is called climacteric peak and the fruits are called climacteric fruits. In climacteric fruits ripening occurs even after harvesting. The climacteric rise is soon followed by a sharp decline.

The non climacteric fruits like grapes and lemon, the respiratory rate gradually decrease after the fruit is harvested without showing any abrupt rise. The peak respiratory rate in climacteric fruits usually corresponds to peak ethylene production.

Application of ethylene hastens ripening of climacteric fruits such as banana, mango, apple and tomato. This is being commercially employed. In non climacteric fruits such as lemon and orange ethylene application does not hasten ripening however rate of respiration increases greatly.

B. Abscission and senescence

Ethylene promotes both abscission and senescence of flowers. The flowers of orchids and roses the most sensitive to externally applied ethylene. Ethylene also

promotes leaf abscission. In general older leaves are more sensitive to ethylene and abscise faster than younger ones. Older leaves produce more ethylene than younger ones. This is probably responsible for abscission of older leaves.

C. Roots on stem cuttings

Application of ethylene promotes callus formation and initiation of adventitious roots on the stem cuttings. Some times adventitious roots may arise on the stem of intact plant as well.

D. Root and shoot growth

Ethylene inhibits linear growth of the stem and root of dicotylidons. The effect increases with increasing concentration.

E. Flowering and sex expression

Application of ethylene causes flowering in pine apple and shift the sex ratio of flowers towards femaleness in several cucurbits and cannabis.

F. Epinasty

Ethylene causes swelling of cells on the upper part of the petiole of the leaf resulting in drooping of leaves (down ward curvature). This is termed as epinasty. It is best exhibited in leaves of tomato, potato and pea etc.

G. Thinning in apple

Thinning of fruits in apple eliminates biennial bearing and also improves fruit size and quality. Application of ethephon at 100 to 300 ppm reduces fruit set. In cotton also ethylene induces this fruit thinning.

H. Exudation of sap and latex

When ethereal is applied to rubber plants, flow of latex continues for a longer duration Etherel probably prevents coagulation of late and consequent blocking of laticiterious ducts.
