Mineral Salt absorption

About 40 types of mineral elements have been recovered from plant ash. Among these 14 have been found commonly. Some of these are ~~Chloride~~, Sulphate, phosphate, chloride, nitrate and nitrite.

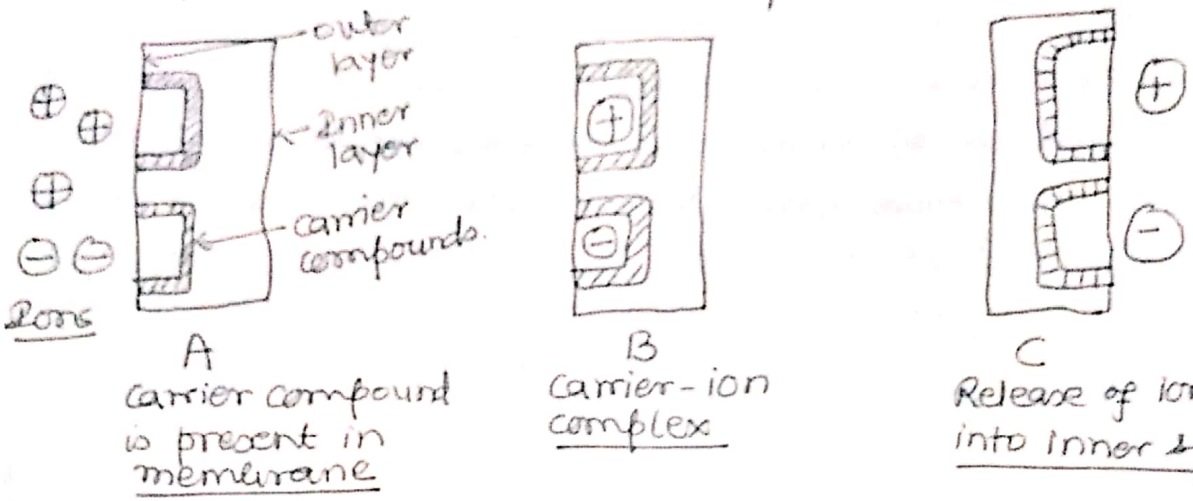
Salt absorption takes place through the intimate contact of the root system with the soil solution. The problem of how the available elements in the soil penetrate the root tissue and how they are transported through the plant, are the main areas of investigations for plant ~~pathologist~~ physiologists. Various theories are proposed to explain the mechanism of mineral salt absorption. Kramer (1949) categorised these into two broad categories:-

① Active Absorption Theory.
② Passive Absorption Theory.

① Active Absorption Theory:- According to the active absorption theory of salt uptake, it is believed that this process is supported by metabolic energy. The transport of ions with the aid of metabolic energy has been termed as 'active absorption'. Various mechanism have been put forward to explain active transport. However, it is universally accepted that the active transport of an ion across an impermeable membrane is mediated through a 'carrier compound', present in the membrane.

② Carrier concept:- This concept was proposed by Hoagland (1937). The most important feature of the carrier concept is the assumption of an intermediate carrier, which may be organic molecules. They combine with the ions of outer space to form ion complex. This intermediate carrier is capable of moving across the impermeable membrane and ions are released in the inner space or cytoplasm. The direction of the movement of ions released in the inner space can not move out and thus are accumulated there.

The saturation effect and specificity of carrier evidences strongly support the carrier concept theory in active salt absorption.



(b) Cytochrome pump hypothesis:- Lundegardh's (1933) proposed this hypothesis. According to this hypothesis, the mechanism of salt absorption is dependent on the following facts:-

(i) Anion absorption is independent of cation absorption.

(ii) An oxygen concentration gradient exists from the outer surface to inner surface of a membrane. This favours oxidation at the outer surface and reduction at the inner surface.

(iii) The actual transport of the anion occurs through a cytochrome system.

Here a quantitative relationship exists between anion absorption and respiration. The inhibition of respiration inhibits anion absorption. This led Lundegardh to propose that transport of anion is mediated through cytochrome oxidase and that cytochrome may be an anion carrier.

This theory has not been accepted and has been criticised by a number of investigators.

(c) ATP theories :- A mechanism for active salt absorption that utilises ATP has been proposed by Bennet and Clark. The investigators have suggested that phospholipids may be important in the transport of ions across membranes. In this transport Leathin, a phospholipid is synthesised and hydrolysed in a cyclic manner, picking up ions on the outer surface and releasing them on hydrolysis into inner surface. This synthesis of at least one of the components of this phosphatide cycle requires ATP.

(2) Passive absorption Theory :- Early workers assumed that inorganic salts were passively carried into the plant with the absorption of water. In passive absorption, metabolic energy is not involved.

Mechanisms of passive absorption :-

(a) Mass flow :- Some investigators believe that ions can move through roots along with mass flow of water. Lopuswinsky (1935) supported this concept. According to this concept, an increase in the transpiration should cause an increase in the absorption of ions. This theory was dicarded on the main objection that in some plants increas in Transpiration results in slow absorption of ions

(b) Ion-exchange :- Ions absorbed to the surfaces of the cell membrane of a tissue may exchange with ions from the external solution in which the tissue is immersed. Let us suppose, the cation K^+ of the external solution exchanged with a hydrogen ion H^+ absorbed to the surface of the membrane. Thus ion exchange mechanism would allow for a greater absorption of ions from the external medium.

© Donnan equilibrium :- The Donnan equilibrium theory takes into account, the effect of fixed or indiffusible ions. A membrane that is permeable to some ions and not to others, ~~which~~ separates the cell from the external medium. suppose that, on the inner side of this membrane, there is a concentration of anions to which the membrane is impermeable (fixed ions). Now if the above membrane is freely permeable to the cations and anions ~~of~~ the external solution. They will diffuse across the membrane until an equilibrium is established. However, addition of cations are needed to balance the negative charge of the fixed anions. Therefore, the cation concentration become greater in the internal solution than in the external solution.

Objections to the Passive Absorption Theory :-

(I) No metabolic energy is involved in passive absorption, whenever we know that in any activity energy is needed.

(II) Passive absorption only accounts for the rapid absorption. In case of slow absorption, metabolic energy is needed.

on account of above facts, passive absorption theory for mechanism of salt absorption has been discarded.

Conclusion :- Now, there are many theories to explain mechanism of mineral salt absorption but much remains to conclude. Passive absorption concepts has to face several criticisms, while active absorption concepts have been widely supported. Therefore, it is believed that one or both of these mechanisms may be involved in salt absorption. According to Wilkins (1969), the knowledge is in more primitive stage and there is need to fill this gap by future investigators as fas as possible.