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Opinion

Intra cellular pH flux and cyclosis in plant cells under abiotic stress

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Ethylene mediates stress responses through ROS and generates proton (H^+) gradient in aquatic and semi-aquatic environments. Hence, pH flux is generated as a motive force at the interface of flowing and stationary endoplasm where microfilaments oriented parallel to streaming (Bradley, 1973). Cyclosis (cytoplasmic streaming), a self-sustaining motion generated by hydrodynamic behaviour and compressible intracellular flow resulting in thermal fluctuations adjusted by ion flux and transport. As per hypothesis, this force in turn maintains the turgor, tonoplast dynamics and continuous transport of sap. According to Wang *et al.* (2015) nitric oxide, a free radicle negatively regulates ABA signalling where its deficiency creates stomatal closure. We found that, pH plays a major role in ABA function and rab gtpases were found to co-localise in guard cells when they are open.

In depth study of abscission zones under confocal microscopy revealed that, the pH flux linked to abscission regulated by ABA and ethylene action. It may be true in plants also as Amy *et al.* (2014) has reported in yeast that, vacuolar acidic lipids are interacting with rab gtpases. These acidic lipids are water soluble and has strong propensity to partition into membranes. In that case, depending up on the pH of the cytoplasm, rab gtpases may interact with myosins and some other yet to be identified moleucles. I differ with Amy *et al.* (2014); when acidic lipids are not available, rab gtpases take the lead even at higher salt concentrations along with myosins and supporting the fact that pH flux plays a major role.

Intracellular streaming in plant cells are, movement of minute cytoplasmic bulbs as observed using GFP: tonoplast arabidopsis lines (Cutler *et al.*, 2000) with a great continuous force, which maintains the intracellular microclimate and viability of the cell. As we earlier found in *Macrotyloma*, that glutathione S-transferases are differentially expressed under stress was reported myosin interacting in chara (algae). This interaction of myosins requires activating molecules and signaling molecules. To speculate, it could be rab gtpases, which activates myosing based on signalling. This leads to the understanding that, rab gtpases are involved in interacting with myosins in transporting the small intracellular *"nunkumilzh kaarai"* (bulbs enclosing cytoplasm within tonoplast) as we observed. These bulbs are not to be confused with endosomes as they are also being carried by rab gtpases (Ueda *et al.*, 2001). Apart from transporting cytoplasmic bulbs, myosin interacting complexes regulates cyclosis, pH flux and organelles transport (Yasin, 2013).

Molecular fluctuation within a bulb reflects in pH flux, regulates movement of cytoplasmic bulb, stabilizing it by fussion with other bulbs by inactivating the interacting motor proteins. If the pH balance is lost cell death initiates leading to necrosis under biotic stress, reduction in number under abiotic stress and abscission in source sink imbalance. These adaptations maintain structural compaction (Yasin *et al.*, 2012) under abiotic stress and prevent disease development under biotic stress. If we combine these results we can confirm that pH flux and cyclosis plays a major role in plant hormone signalling and stress response.

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