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Waterproofing Crops

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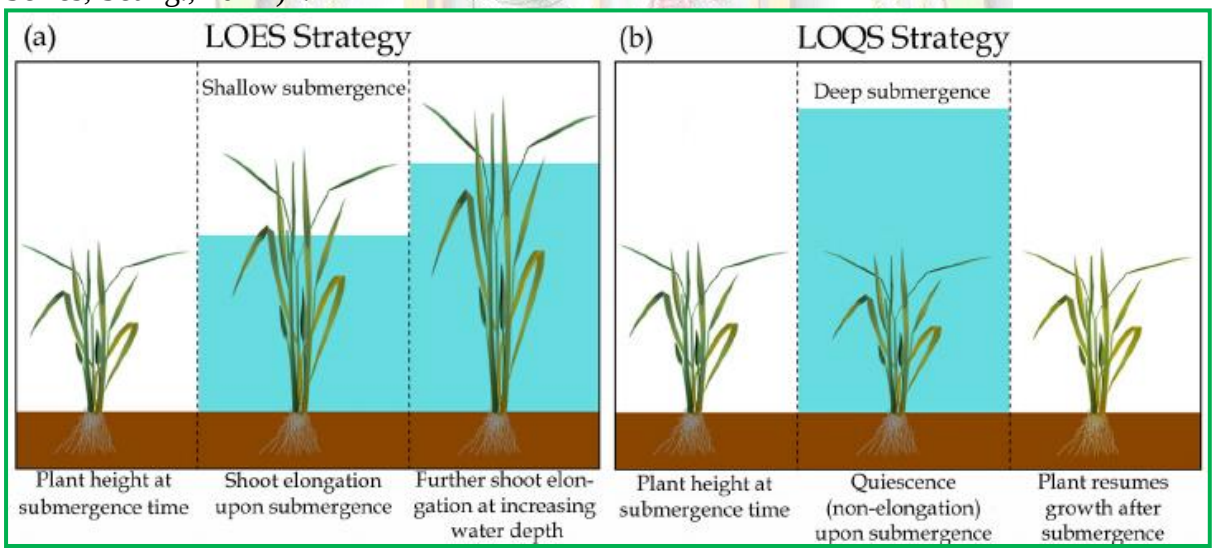
In farming regions all over the world, in past 50 years, the extremes in water availability like drought and flood had increased its frequency. These two abiotic stresses are accounting to a loss of many US billion dollars all over the world. The crops which are mostly affected by these abiotic stresses include Rice, Maize, Soybean, Wheat and Cotton. Among these, the most flood-threatened crop is Rice. At present, over 35% of worlds rice acreage is flood prone and much of this is in regions of Asia and Africa which are characterized as food insecure continents.

This problem is considered as a major one and became a major international goal for the rice breeders to meet the anticipated needs of growing hunger mouths.

Floods and flooding survival mechanisms

The term flooding FIS generally used to describe the inundation by the water of all or part of the plant. Waterlogging is used to describe flooding of the root system and submergence to describe the situation when most or all aerial tissue is under water (Julia Bailey-Serres, Seung., 2012) .



Both of these strategies involve ethylene-mediated signal transduction (Rashmi Sasidharan et al , 2012) , even though they are different. The plants which are present in wetlands show some adaptive features like adventitious roots formation, aerenchyma formation, thinning of leaf cuticle, re-orientation of chloroplasts etc. Sometimes, the leaves may have a sufficiently hydrophobic cuticle for proper diffusion of oxygen and carbon dioxide which indirectly helps in respiration and photosynthesis respectively in under water.

Ethylene regulation of adaptive growth responses to floods: An essential mediator of flooding responses is ethylene. This gaseous hormone is released normally in plant cells and gets diffused under normal condition. But during submerged conditions thus ethylene gets trapped in plant cells and induces much more production of this hormone through signal transduction. The characterization of two quantitative trait loci (QTL) in rice demonstrated the importance of ethylene in flooding responses.

Quiescence strategy of submergence -Tolerant Rice: In submergence tolerant variety 69% of phenotypic variation is conferred by the SUB1 locus of chromosome9. Under complete submergence, the plants with SUB1 locus of FR13A are capable of surviving for 2 weeks or more than that(fig:3). This is a multigenic locus having 2 or 3 genes which are designated as SUB1A, SUB1B & SUB1C. The SUB1A gene is enough for tolerating submergence whereas SUB1B & SUB1C are quiescent.

Underwater escape by deepwater Rice: Rice varieties which are cultivated in deep waters are having a capability to increase the submerged stem internodes by about 25cm/day.

Alteration in gene expression and metabolism in response to low oxygen and flooding: Gene transcript regulation: Many studies have examined low oxygen and flooding stress at the transcript and metabolite levels. Analysis of transcriptomes has been reported for Arabidopsis, cotton, poplar, rice, soybean under hypoxia or anoxia (0% - 8%) and flooding conditions (Mustroph A et al ., 2009) .

Primary metabolism: In response to oxygen depreciation and flooding, evaluation transcriptomes, translation metabolites and proteomics (in case of rice and wheat) are done.

Conclusion

There is growing evidence of conserved strategies that enable flooding survival and involve signal transduction as a consequence of altered homeostasis in ethylene, oxygen and energy reserves. The ethylene - regulated process interact with modules controlled by other hormones, including ABA, GA & auxin as well as ROS & NO, to control elongation growth and aeration. Evolution tinkered with key circuitry that regulates flooding tolerance to enable successful tolerance and avoidance strategies. It is anticipated that future studies that integrate genomic technologies with eco-physiological studies will prove instructive for the breeding and engineering of more waterproof crops.

References

1. Rashmi Sasidharan , Sjon Hartman , Zeguang Liu , Shanice Martopawiro , Nikita Sajeev , Hans van Veen , Laurentius A.C.J. Voesenek (2017) Signal dynamics and interactions during flooding stress , plant ecophysiology , institute of environmental biology , Utrecht university , Netherlands.
2. Tomomi abiko,lukasz kotula,katsuhiro shiono,al imran malik,timothy david colmer,mikio nakazono (2012) Enhanced formation of aerenchyma and induction of a barrier to radial oxygen loss in adventitious roots of *Zea nicaraguensis* contribute to its water logging tolerance as compared with maize (*Zea mays* ssp. *mays*)
3. Michlcova D, Gilbert JC , Lawson CS , Gowing DJG , Marrs HM (2011) The combined effect of water logging , extractable P and soil pH on α-diversity : a case study on mesotrophic grasslands in UK.