DYNAMICS OF MEMBRANE LIPID COMPOSITION OF UPLAND COTTON (*GOSSYPIUM HIRSUTUM*) SEEDS IN RESPONSE TO COLD WATER IMBIBITION

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Abstract

Cold stress is a major abiotic stress in tropical crops like cotton. The imbibition of cold water at germination stage severely limits the germination performance of cotton resulting in non- uniform and poor crop stands. The major damage during cold germination is caused by the increased rigidity of the cell membranes of seeds. The water imbibition by rigid cell membranes causes perturbations which ultimately results in excessive solute leakage and thus seed metabolic dysfunction. As a major component of the cell membranes, lipids play an important role in maintaining the membrane integrity under cold stress. The cold acclimating seeds remodel their membrane lipid composition to provide cells with active surface protection, structural and signaling functions. Phospho- and sphingo-lipids are two major membrane lipids, unique properties of which regulate the dynamic properties of biological membranes. Keeping in view the role of lipids in cold temperature resilience, we profiled changes in the lipid composition of cold tolerant and -sensitive seeds after imbibing them for 3 hours at 12°C and 30°C. The results showed that the cold tolerance during germination is directly linked to the accumulation of sphingolipids which help to stabilize the cell membrane under cold stress. Sphingolipids interact with other membrane lipids and maintain membrane flexibility under cold stress. The phospholipids which act as a substrate for anti-oxidants, membrane stabilizers and osmo- protectants increased in cold tolerant genotype as compared to that of cold-sensitive genotype. However, the phospholipids which are directly involved in the recycling of macromolecules from dead cells observed to increase only in cold-sensitive seeds. Besides lipid classes, cold tolerant seeds increased the proportions of unsaturated fatty acids attached to the lipids. The unsaturated fatty acids create kinks and maintain membrane flexibility by pushing membrane lipids away from each other. The current study thus clearly showed that the low temperature modulates the lipid composition of cellular membranes which ultimately affects the germination performance of seeds.