Title Internalization of microorganisms in fruits and vegetables

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Abstract

Purely physical processes appear responsible for most microbial ingress into plants. Growth processes enable certain plant pathogenic fungi to penetrate plant surfaces directly or indirectly, whereas all other microorganisms enter through wounds or natural openings. Microbial ingress is facilitated by free water that extends from the plant surface through pores or wounds into intercellular air spaces. Plant tissues contain an extensive system of air spaces. Intercellular spaces are lined with cellulose, himicelluloses and pectic substances that are hydrophilic; the air spaces are highly humid but usually free of liquid water. Waxy materials usually cover plant surfaces and may extend into natural openings. The wax forms a hydrophobic barrier that limits the entrance of water into the air spaces. Liquid water penetrates natural pores only if external or internal pressures overcome the hydrophobic barriers. The impact of water on plant surfaces (wind-driven rainfall or water under pressure), the cooling of flooded tissues (negative internal air pressures), or water pressure from the root system (gutation) can congest or flood intercellular airspaces with water. Cell sap often congests intercellular spaces in wounds that result through growth activities such as emergence of secondary roots, exposure to weather related stresses, or crop cultural activities such as harvest or pruning. Continuous columns of water from plant surface to intercellular spaces enable microbes to move into tissues by diffusion. Alternatively, microbial suspensions are drawn into congested tissues by capillarity. Once internalized, microbial structures are protected from desiccation, contact with UV, chemical washes, etc. Although certain physical forces responsible for internalization can be minimized, others such as weather events appear uncontrollable. Successful management depends on keeping hazardous microbes away from the crop.