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Ethylene mediation of programmed cell death – possible mode(s) of action

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Evidence has accumulated that programmed cell death in plants exhibits similarities to apoptotic and autophagic cell death pathways in animal cells. Following treatment of plant cells with biotic (e.g. pathogenic bacteria, virus, fungal toxins) or abiotic (UV radiation, ozone, heavy metals) elicitors, cell death often shows typical features of animal apoptosis such as cytoplasmic shrinkage, chromatin condensation and nuclear and DNA fragmentation. During plant developmental events, cell death is often accompanied both by symptoms of animal autophagy (disappearance of organelles, authophagic vesicles, increased size of lysosome/vacuole) and by apoptotic-like features. A specific class of cystein proteases called caspases is thought to be responsible for these apoptotic features in animal cells. The similar morphology of dying animal and plant cells indicates that the underlying biochemical pathways may share common elements. Ethylene is an important mediator of plant cell death during e.g. plant-pathogen interactions, environmental and abiotic stresses and a variety of developmental processes. Ethylene's mode of action under such diverse conditions is currently not known. Apparently, ethylene mediates some critical step in a shared cell death pathway. Ethylene markedly stimulated cell death in tomato suspension cells in response to chemical treatment. This effect of ethylene was related to the amount of hydrogen peroxide produced. The general proposition can be made that ethylene apparently increased the oxidative stress invoked by the primary (cell death-inducing) stress. This indicates that the stimulatory role of ethylene in symptom expression may be through increased ROS levels in a number of processes where oxidative stress is thought to be involved in cell death (temperature extremes, ozone, wounding, pathogen challenge, senescence). The mechanism of ethylene-enhanced oxidative stress may vary from case to case. The possible modes of action of ethylene in enhanced ROS levels are discussed.