UMD-BARC SYMPOSIUM: Climate Change Adaptation for Food and Environmental Security

Biochemical and Molecular Responses of Crops to Climate Change

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Evolution of Analytical Techniques in Plant Science

How do Molecular and Biochemical Techniques Contribute to Understanding the Effects of Climate Change on Plants

1. Older: Focused on single processes:
    1. Studied a single enzyme/gene/metabolite, etc.
    2. Reliance on optical techniques

2. Newer: Multiple processes are studied:
    1. Goal is to measure all enzymes/genes/metabolites, etc.
    2. Reliance on mass spectrometer
    3. Modern "Omics" techniques: transcriptomics, metabolomics, lipidomics, proteomics, ionomics

3. Advantages: Information on linkages, networks, interactions and regulation

Dimensions of the plant genome

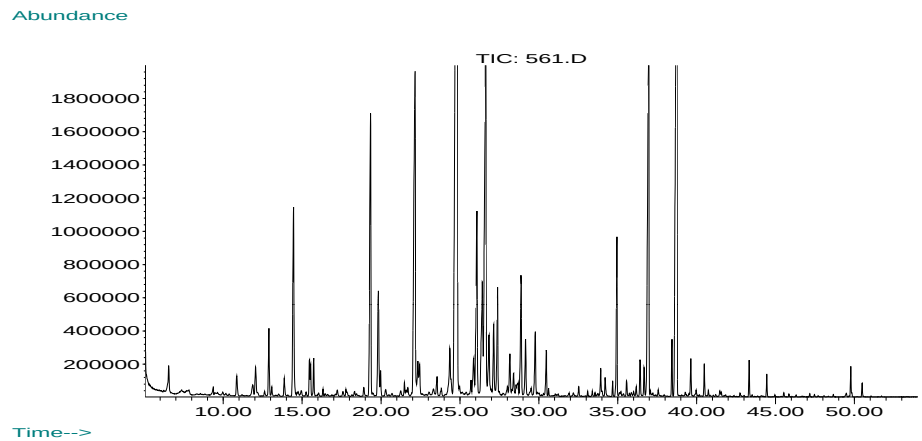
Arabidopsis thaliana

26,000 genes

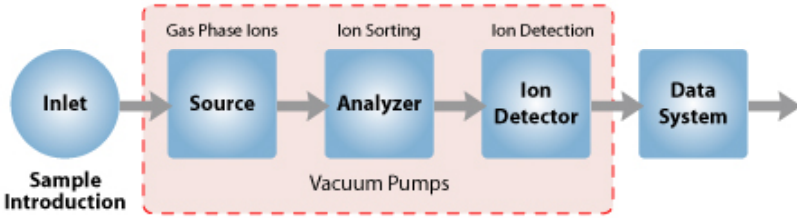
100,000 proteins

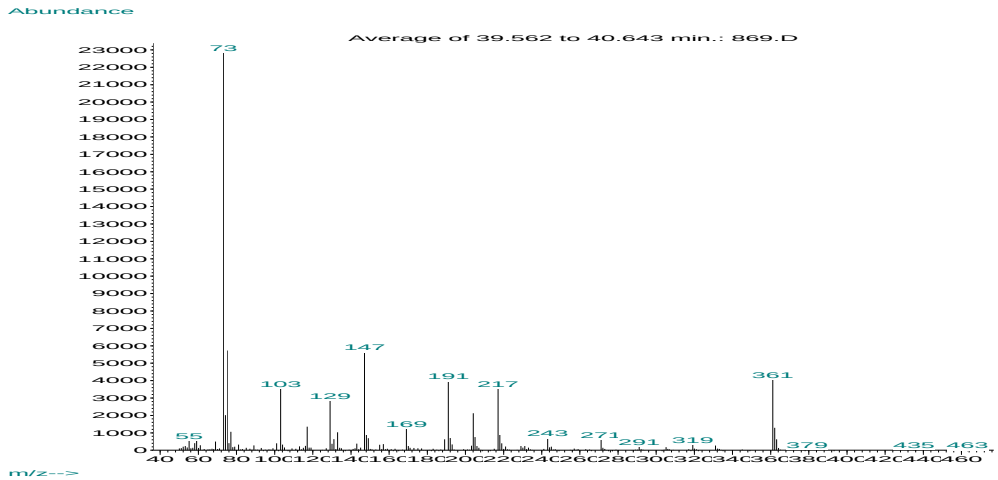
> 250,000 metabolites

Metabolite Analysis by GC-MS

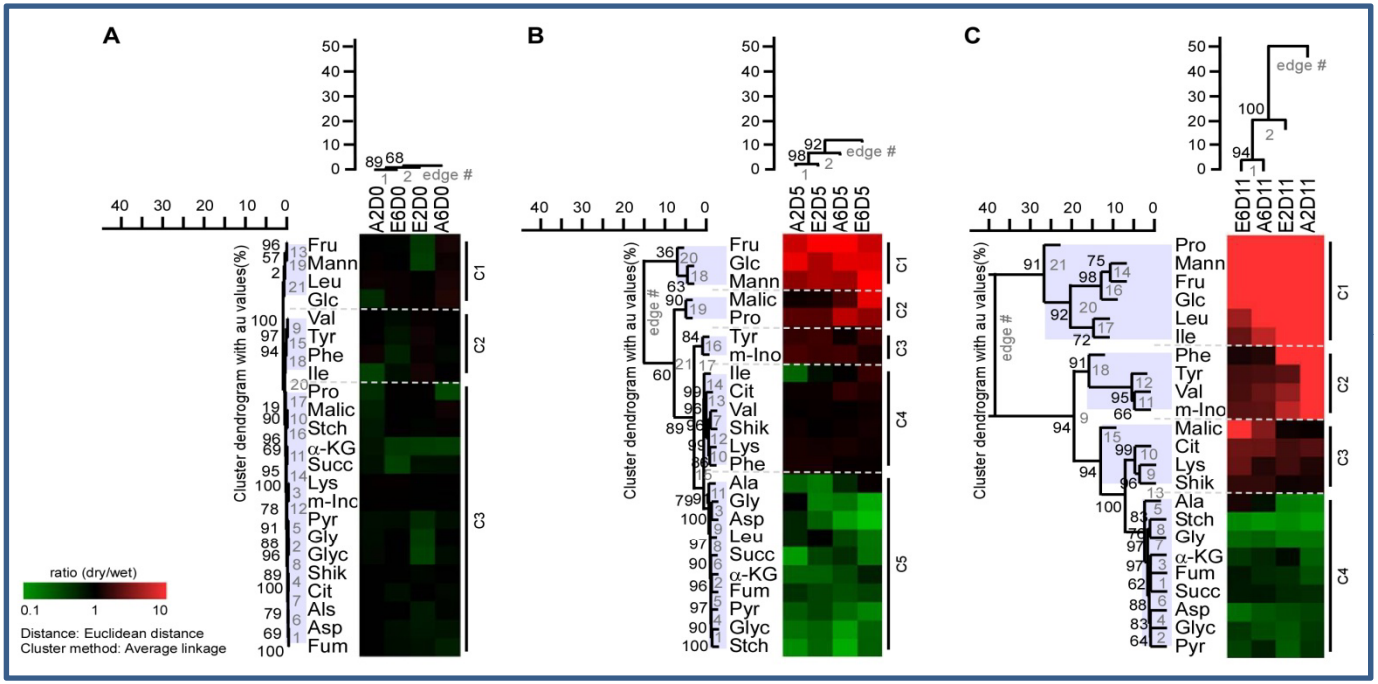


Mass spectrometer



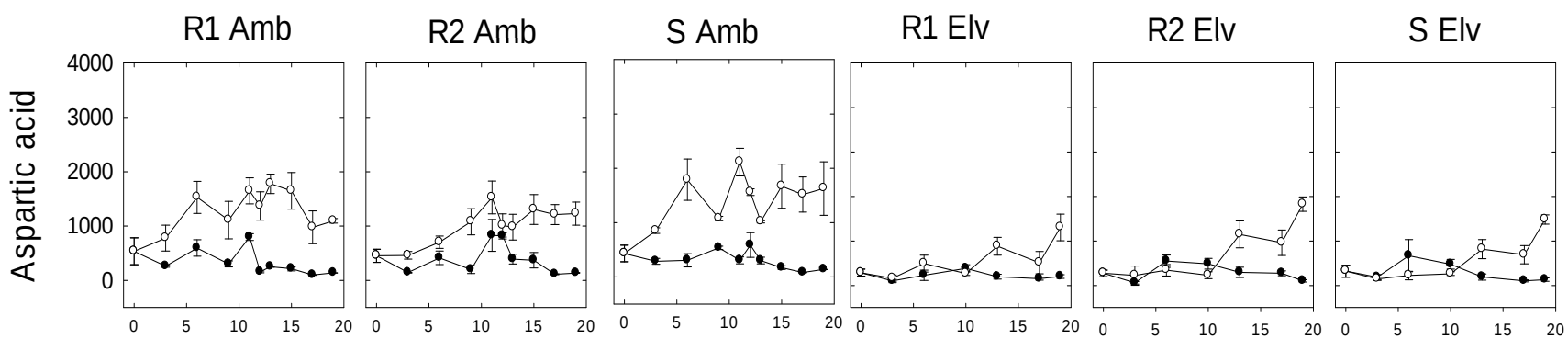


How do you handle large datasets?



Statistical approaches identify and quantify differences among treatments

Hierarchical clustering identifies relationships between treatments and metabolites

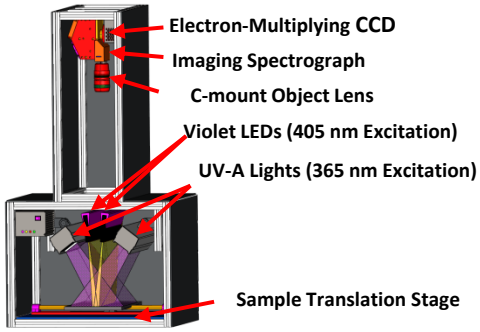


Systems Biology Combines "Omics" techniques ?

Genotypes differing in drought tolerance

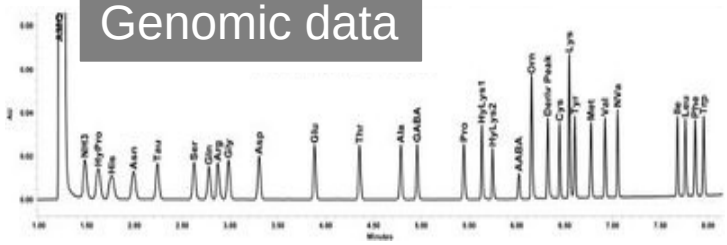
GC-MS

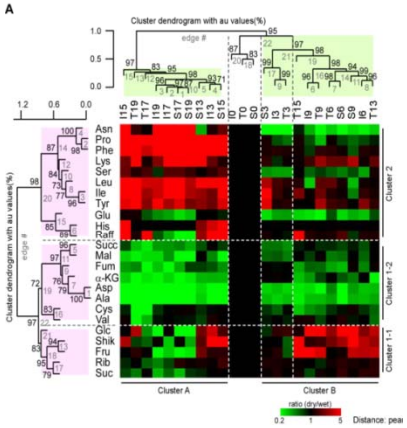
UPLC



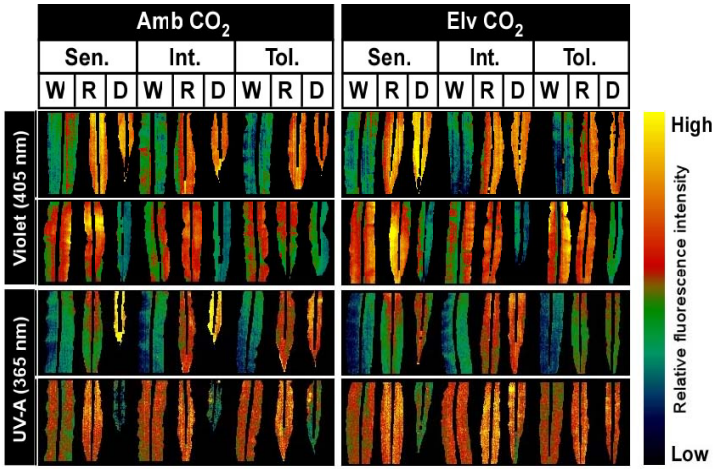
Hyperspectral imaging

Genomic data





Phenomic data

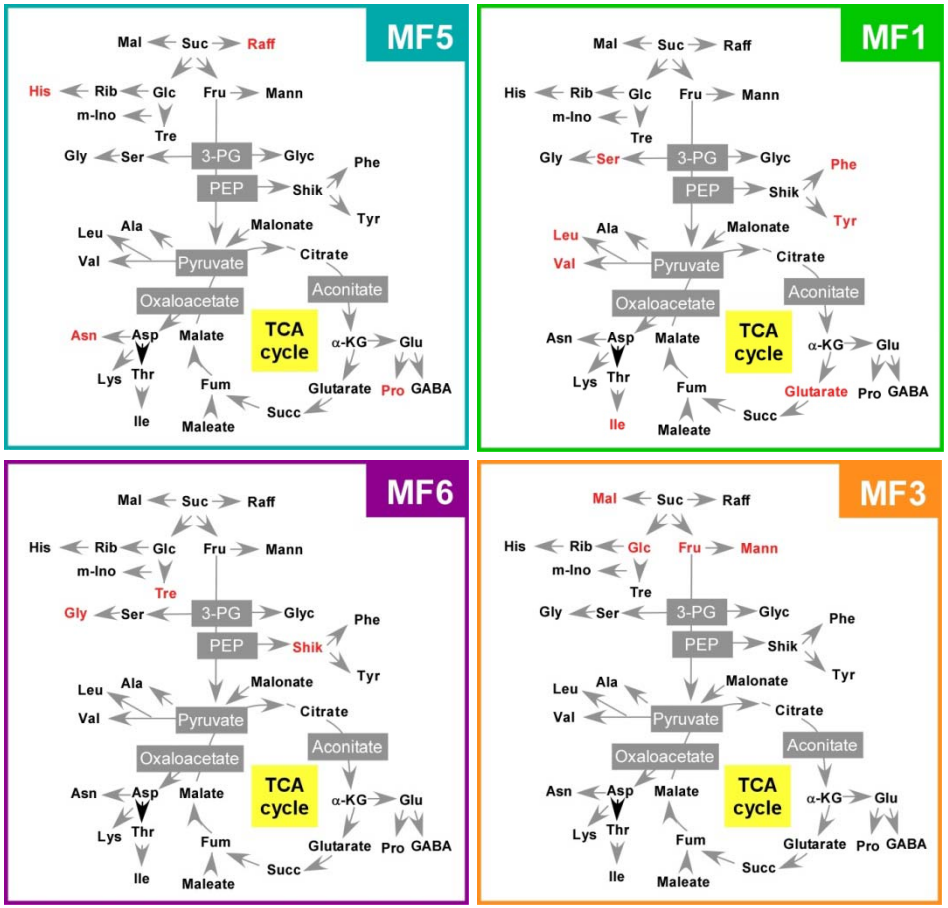


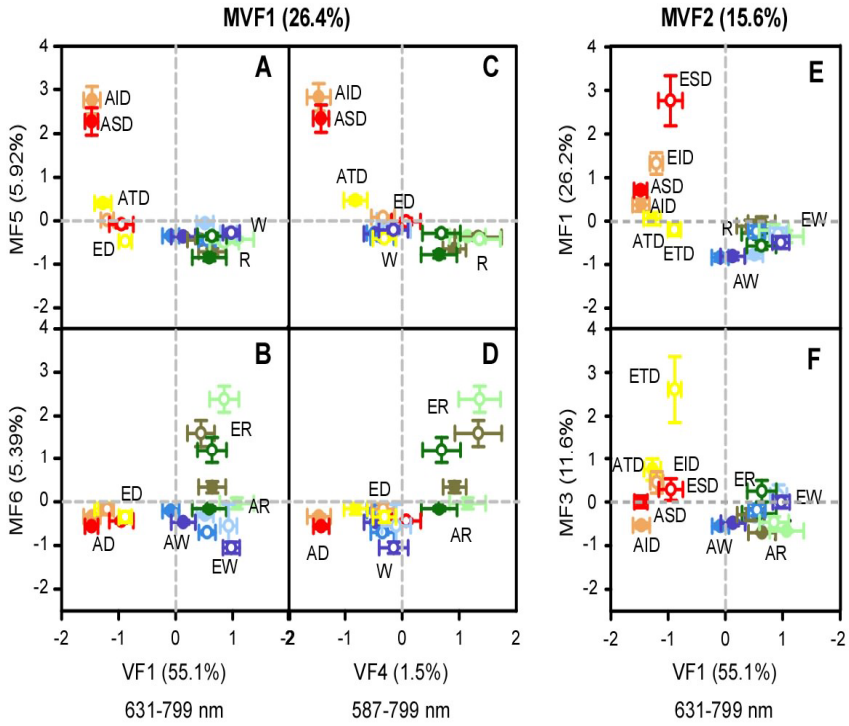
Metabolite/transcript profiling

Statistical analysis

to identify phenotypic features associated with particular genomic clusters

Emission 587-799 nm with Violet excitation





Metabolomics and Phenomics data from the same experiment can be combined using Factor Analysis.