Cleaning house is one way plants respond to inside and outside changes

Thank you! ADVANCE Nominators Colleagues Students

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Improving plant productivity impacts:

- Plants make their own food and our food
- Source of energy- fossil fuels and renewable biofuels
- Affect global environment
- Producer of flavorings, dyes, insecticides, pharmaceuticals, or precursors.



Plants cannot move from one location to another and must "deal" their environment- developmental and biochemical changes



New environment requires changes

Example of long term changes



New environment requires changes

Example of short-term changes Germination conditionsif favorable, yes If not favorable, no



Similarly, developmental transitions require compositional change

New environment/developmental changes requires changes

Need change in workers in cells -Proteins

Ones not useful destroyed New ones present

What are some of the questions my lab asks?

- What is the specificity and regulation of destruction of workers- proteins?
- What role does protein destruction play in life of plants-

in response to stress, developmental changes?



"Marking" proteins with ubiquitin tag targets them for proteolysis via the proteasome



What regulates addition of ubiquitin tag?



Lets rephrase these questions

How is ubiquitin attachment controlled? -Focusing on transcription factors- proteins that regulate the expression of genes

Two different families of TFs:

Ones involved in developmental changes: IAA proteins

Ones involved in stress-induced changes: ABF proteins

Ubiquitin is a protein modifier of proteins



Discovered as a requirement for *in vitro* protein degradation in immature red blood cell extracts.

Unusual- Ubiquitin covalently linked to εlysyl groups on protein via C-terminus

Requires enzymes to take ubiquitin on and off

The Ubiquitination Pathway



Central to Specificity of Ubiquitination is interactions in E2-E3-Target Complex



Where is the regulation?

- Interaction of target protein with E2/E3s
- Presence/absence/localization of E2/E3s
- Activity of E2/E3



Genes encoding ubiquitin and ubiquitination enzymes in one plant species



Measure how fast proteins go away



Need to have a way to identify the protein

Synthesis

Protein Protein Protein Protein Protein

Block synthesis



Protein Protein Protein Protein Protein

Block synthesis



Protein Protein Protein Protein Protein IF degradation is occuring.....

Block synthesis With CHX



IF degradation is occuring.....

Protein Protein Protein Protein

Block synthesis With CHX

esis

IF degradation is occuring.....

Protein Protein

Block synthesis With CHX



IF degradation is occuring.....

Degradation

Protein goes away!

IAA goes away fast, but requires specific parts of protein



Loss of protein in visual form



ABF3



Identify effect of change on degradation





Compare how much left over time Need to have a way to identify the protein

Identify effect of change on degradation





Control treated Treat with developmental ↓ Hormone- indole-acetic acid ↓ Inhibit new synthesis of protein ↓

Compare how much left over time Need to have a way to identify the protein

Exogenous Auxin increases degradation rate of AUX/IAA:LUC



Change in IAA protein level is FAST



Minutes after addition of 2,4-D or mock

Small molecule-IAA-regulates E3-IAA protein interaction



Work of M. Estelle (UCSD), N. Zhang (UW), O. Leyser (Sainsbury) laboratories

Auxin signaling



What about ABF proteins?

Identify effect of change on degradation





Control treated



Experimentally treated-Treat with environmental stress Chemical- ABA abscisic acid

of protein

Compare how much left over time Need to have a way to identify the protein

The opposite happens- protein is stabilized!

myc-ABF3

Mock pre-treatment



ABA pre-treatment





Stress compound ABA-E3 protein interaction



Conclusions

One way plants "sense" change is to remodel the proteome to optimize growth for new conditions.

Protein degradation is important to achieve house cleaning in response to environmental and/or developmental changes.

The changes in degradation can be regulated and complex.

In 2 examples here:

IAA proteins are degraded **more rapidly** in response to hormone, IAA

But, ABF proteins are **stabilized** in presence of stress or stress hormone+ +less is known, current focus.

Plant Life is tough!



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