

Plant SUMO and Ubiquitin

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Multiple isoforms of SUMO (small ubiquitin-related modifier) exists in plants. SUMO conjugation (sumoylation) of some proteins can regulate their activity and is associated with stress response. Enzymes include **SUMO activating enzyme (SAE1, SAE2)**, **SUMO-conjugating enzyme (SCE1)**, **SUMO ligase complex (includes SIZ1, HPY2)**, and **SUMO-specific proteases**. SUMO conjugation plays a role in suppressing defence signalling in non-infected plants.

SUMO proteases include:

ESD4,
 ELS1 (also called AtULP1a)(ADA2b is an ESD4 interactor and is SUMOylated in Arabidopsis)
 OTS1 (OVERLY TOLERANT TO SALT1),
 OTS2 (OVERLY TOLERANT TO SALT2)

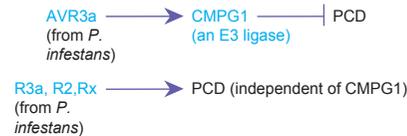
SUMO E3 ligases include:

AtMMS21 (which mediates cytokinin signaling regulating root meristem cell proliferation),
 SIZ1 (which negatively controls ABA signaling through the SUMOylation of ABI5),
 HIGH PLOIDY2 (HPY2) (functions as a repressor of endocycle onset),

SUMO1 targets include:

WRKY3, WRKY4, WRKY6, WRKY33, WRKY72

Ubiquitylation is generally associated with protein degradation, but mono-ubiquitination has different consequences to polyubiquitination. Further, depending on which amino acid is ubiquitinated may also affect the subsequent role of the protein. Some ubiquitinated proteins may therefore be involved in a proteasome-independent function such as signal transduction.

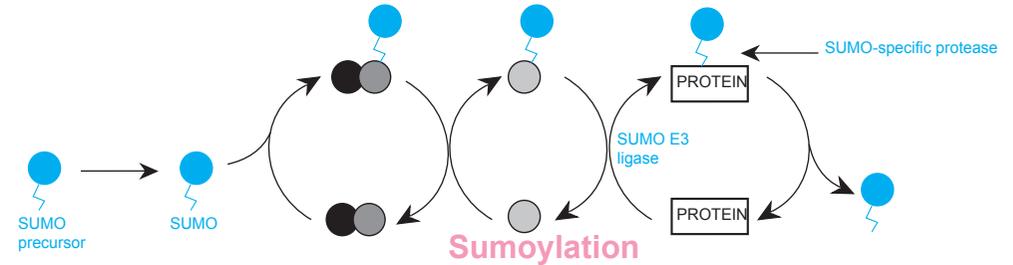


The COP9 signalosome (CSN) is a multi-protein complex that regulates the activities of cullin-RING E3 ubiquitin ligases (CRLs). CSN is involved with plant defense responses such as jasmonate-dependent responses.

Conjugation of the ubiquitin-like modifier NEDD8/RUB1 (neddylation) is a posttranslational modification of the cullin subunits of cullin-RING-type E3 ubiquitin ligases.

The potato protein Star encodes a RING finger protein and is a putative E3 ubiquitin ligase.

SUMOylation of the heat shock transcription factor AtHsfA2 occurs in response to heat stress. AtSUMO1 physically interacts with AtHsfA2 suggesting it is involved in regulating AtHsfA2.

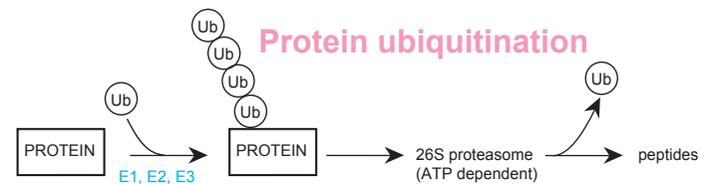


Information on possible SUMO targets is available at : <http://www.landesbioscience.com/journals/psb/article/14256/>

SUMO conjugation postulated to transform transcription activators into repressors (see http://www.landesbioscience.com/journals/psb/van_den_BurgPSB5-12.pdf)

Poly-SUMO chains can promote proteolytic turnover of protein substrates.

There can be cross talk between SUMO and ubiquitin pathways with some proteins being conjugated to SUMO as well as ubiquitin resulting in antagonistic, synergistic or multiple outcomes. Modification of proteins by SUMO can target them for ubiquitination. SUMO-targetted ubiquitin ligases are called STUbLs. Deubiquitinating enzymes may be involved in suppressing plant cell death, i.e. a negative regulator of HR.



E1 = ubiquitin activating enzyme
 E2 = ubiquitin conjugating enzyme
 E3 = ubiquitin ligase

E3 ligases can be divided into single-subunit E3 ligases or multi-subunit E3 ligases

AtSAP5 has E3 ubiquitin ligase activity in vitro. Overexpression of AtSAP5 correlates with up-regulation of drought stress response gene expression.

At3g02480 = UBC32, ubiquitin protein ligase is up-regulated in response to drought.