

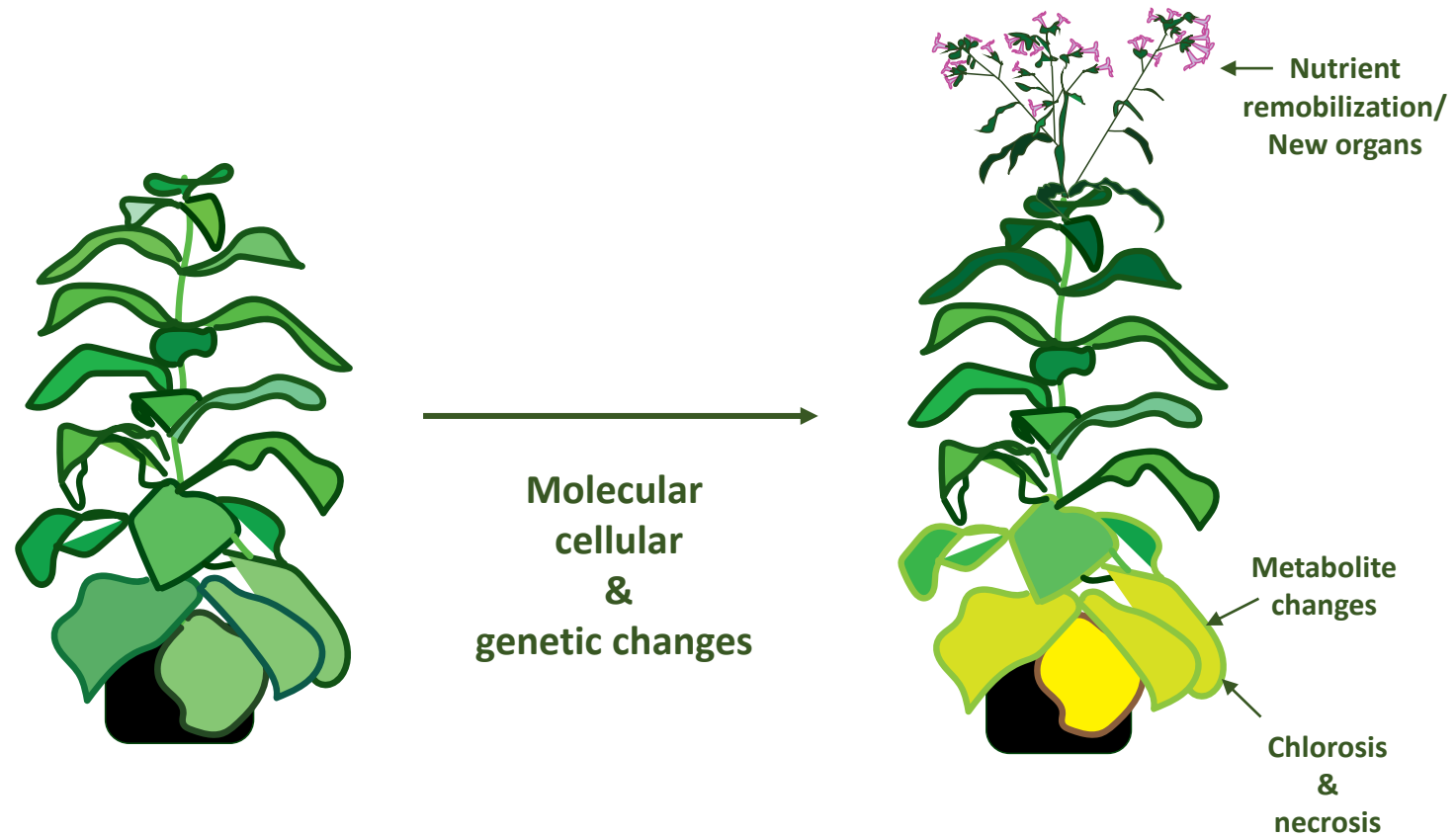
Dynamics of molecular leaf senescence processes in cured Virginia tobacco cultivar K326

Dr. Cecilia Cheval, Post-Doctoral Fellow

Leaf senescence

Senescence: process of aging in plants

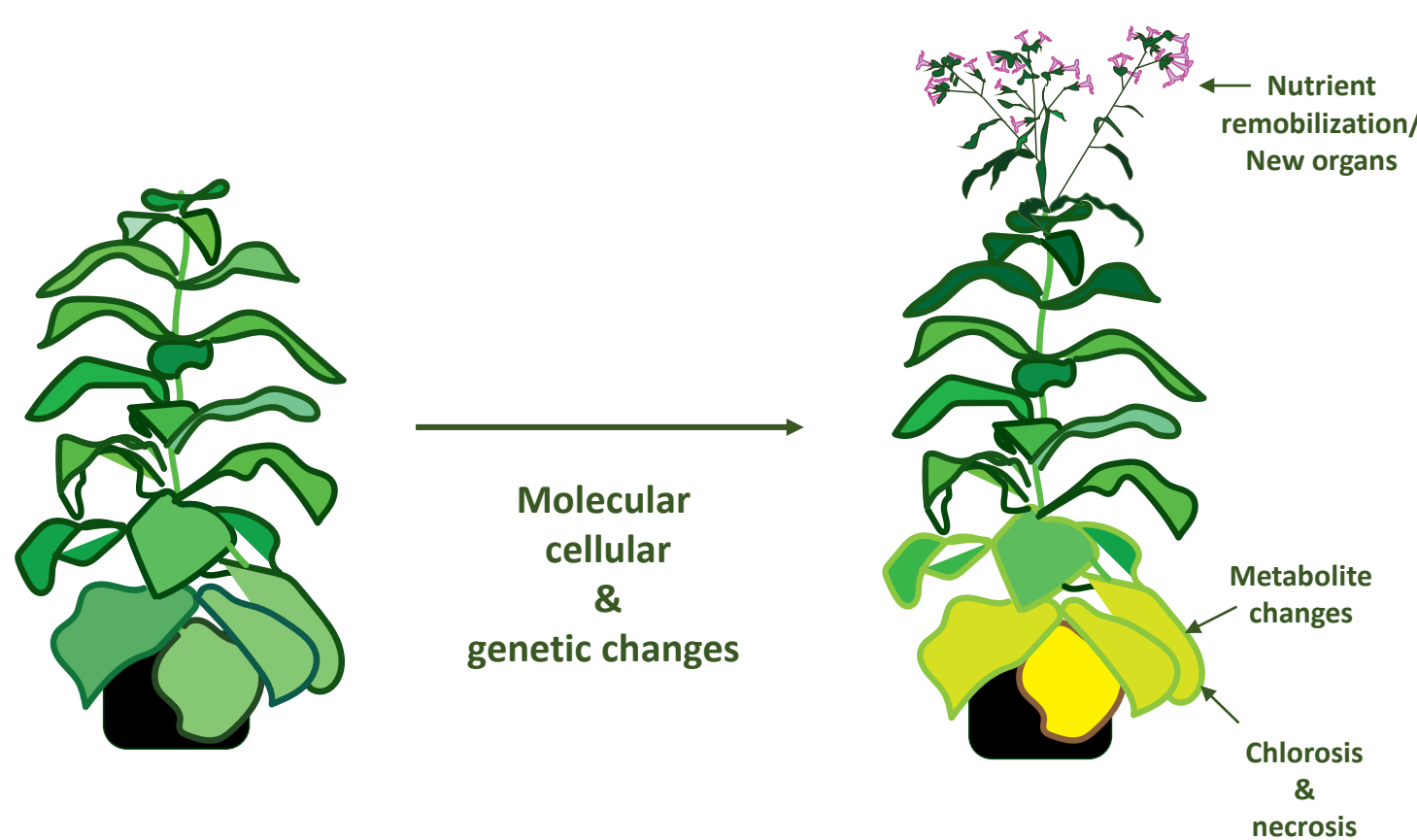
Leaf senescence: terminal phase of the developmental process of a leaf



Leaf senescence

Senescence: process of aging in plants

Leaf senescence: terminal phase of the developmental process of a leaf



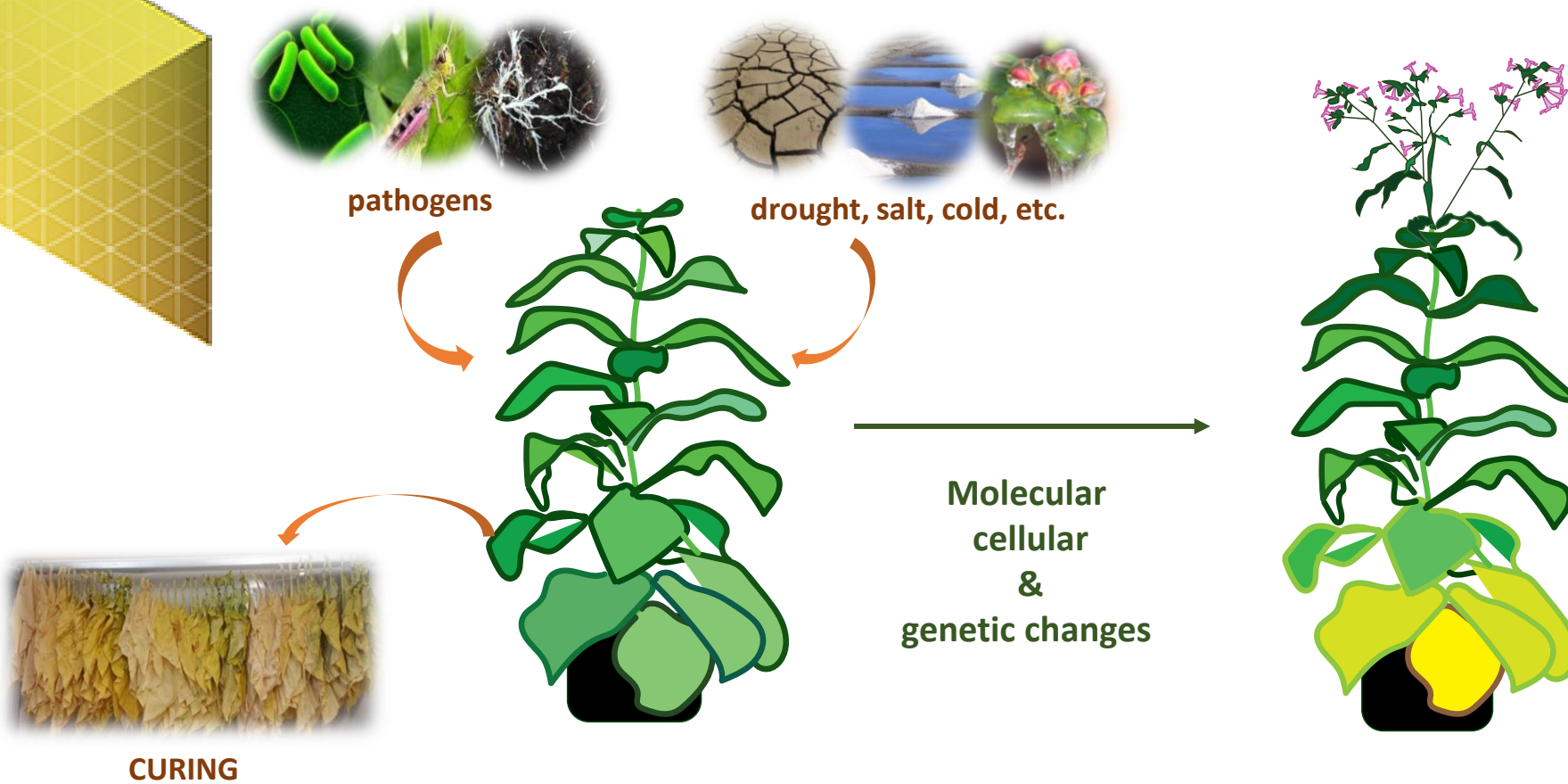
Relevance for agriculture

Premature senescence
Short-shelf life of fruits/ vegetables

Loss in grain filling

Loss of biomass yield

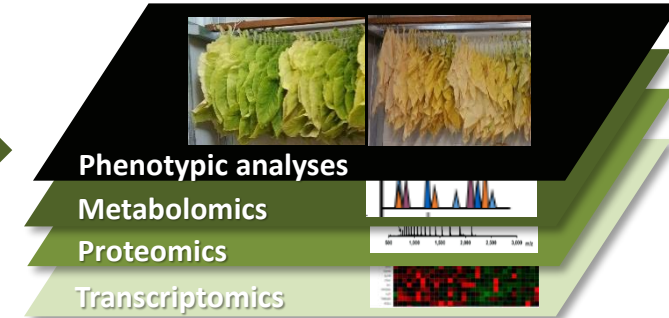
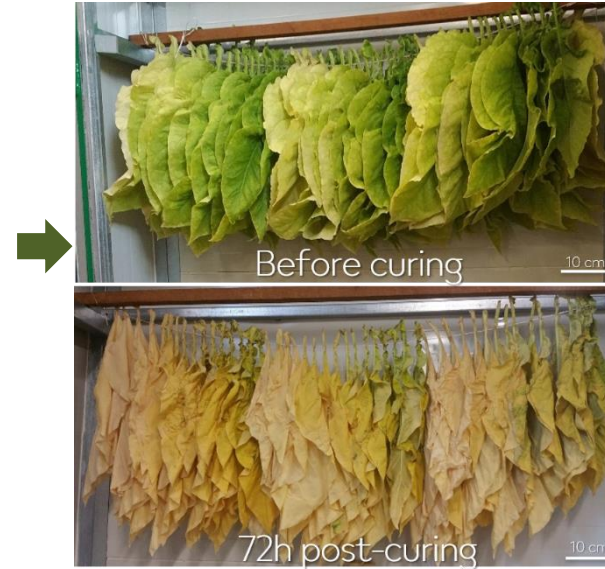
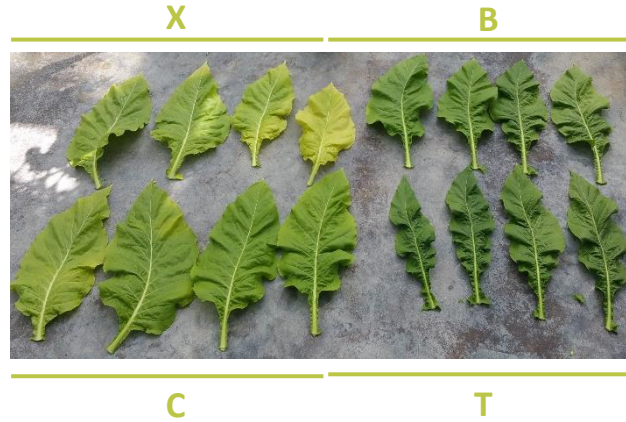
Leaf senescence



What are the molecular mechanisms triggered during curing-induced senescence of leaf tissue?

What is the dynamics of these molecular processes during curing?

Experimental design on K326



Harvesting of leaves from stalk positions X, C, B & T from plants grown in greenhouse (& field)



Curing on a Flue-curing Barn for 72 h
Harvesting of samples at 0 h, 6 h, 24 h, 48 h, 55 h, 72 h



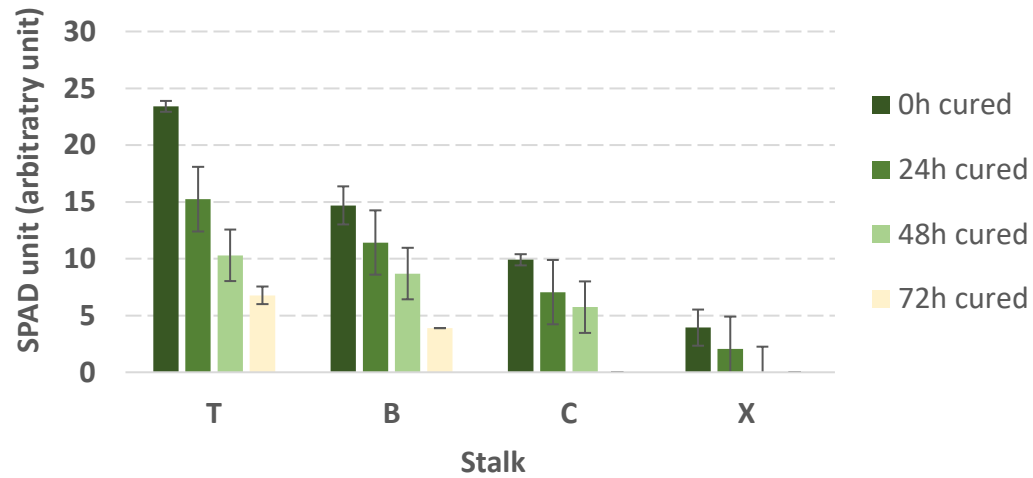
'Omics' analyses

K326 'CURING PROFILE'

Metabolites
Proteins
Genes

Phenotyping of K326 plants during curing

Chlorophyll content



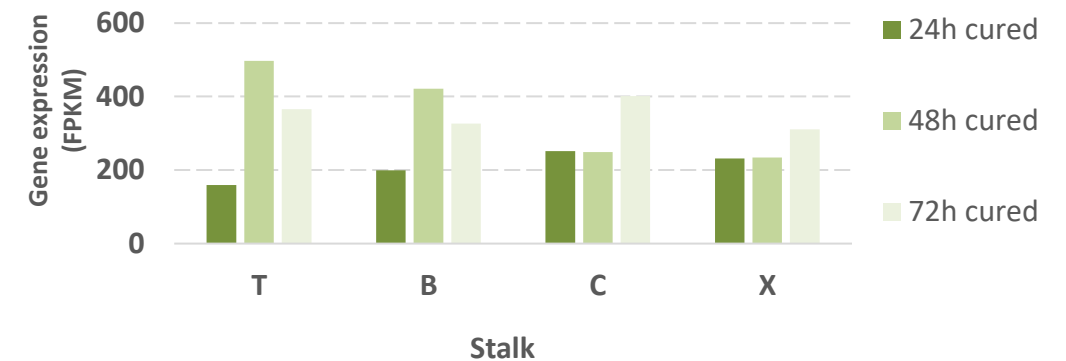
Chlorophyll content

NtSGRL



Senescence marker gene qRT-PCR

NtSGRL



Senescence marker gene RNA-seq

Global molecular changes during curing



T

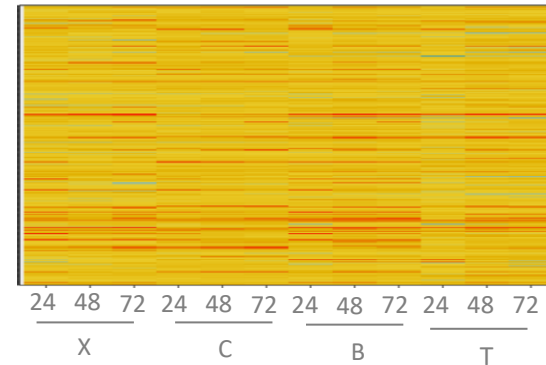
B

C

X

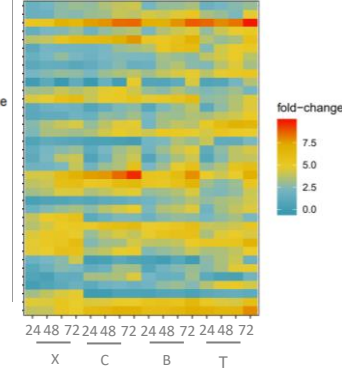
Expression (231 genes)

pos_transcriptomics
foldChange >= 4

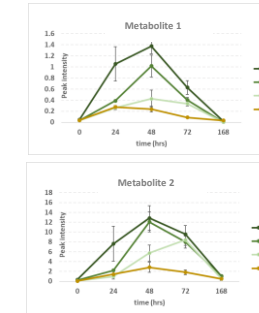


Proteins (37 proteins)

pos_proteomics_DIA_nolow
foldChange >= 4



Metabolites

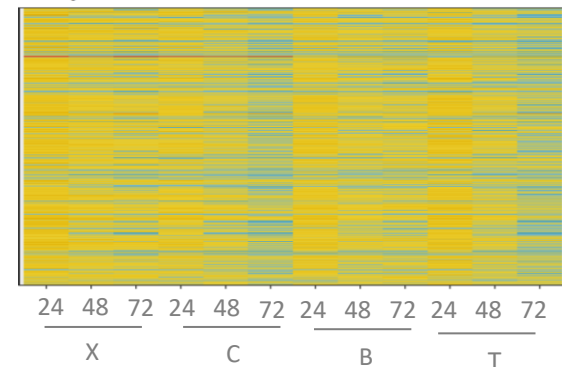


Up-regulated components

Amino acid changes
Sugar accumulation
Polyamines
Hormones (JA, ET, GA)
Senescence markers
Apoplastic & cell wall
Abiotic & biotic stress (SAR)

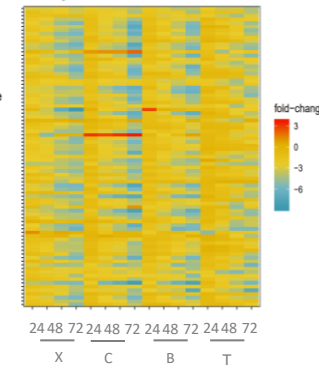
Expression (351 genes)

neg_transcriptomics
foldChange <= -4

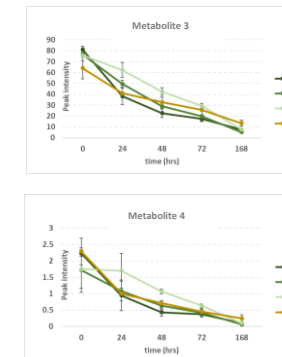


Proteins (82 proteins)

neg_proteomics_DIA_nolow
foldChange < -4



Metabolites



Down-regulated components

Chloroplast
Photorespiration
Calvin-Benson cycle
Apoplastic signalling (RLKs)

JA: Jasmonic acid
ET: Ethylene
GA: Gibberellic acid
SAR: Systemic acquired resistance
RLKs: Receptor-like kinases

Spatial molecular changes during curing



T

B

C

X

RNA splicing
Apoplastic & cell wall (Lignin)
Chaperones
DNA repair

SINK/NON-SENESCING

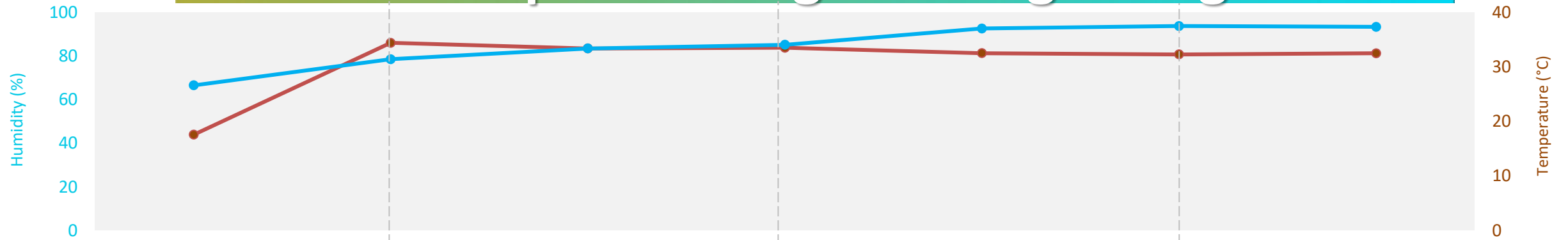
Abiotic & biotic stress
Hormones (ABA, ET)
Degradation (proteases)
Sugar metabolism

SOURCE/SENESCING

ET: Ethylene

ABA: Abscissic acid

Temporal changes during curing



Up-regulated

Carbohydrate metabolic process

Hormone biosynthesis and signalling
(ET, JA, GA)

RLKs/Cell Wall

Re-organization, transport, localization

RLKs/Cell Wall

Senescence markers/ cell death/ SAR

Chaperones

0 h

6 h

12 h

24 h

48 h

55 h

72 h

Down-regulated

Photosynthesis

Post-translational modification

Photorespiration

RLKs

Mono-oxygenases

JA: Jasmonic acid

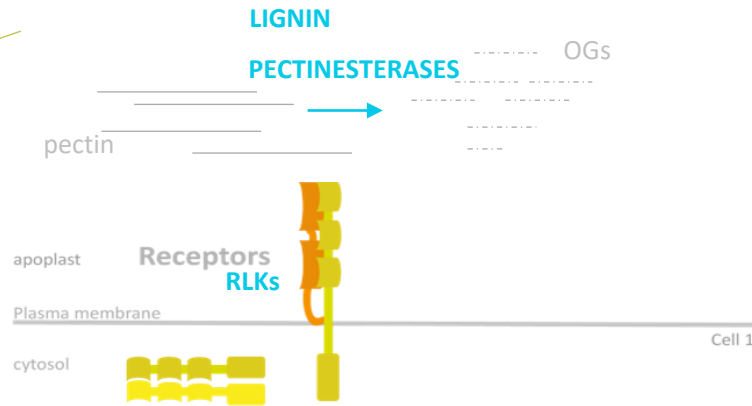
ET: Ethylene

GA: Gibberellic acid

SAR: Systemic acquired resistance

RLKs: Receptor-like kinases

Cellular and molecular control of leaf senescence

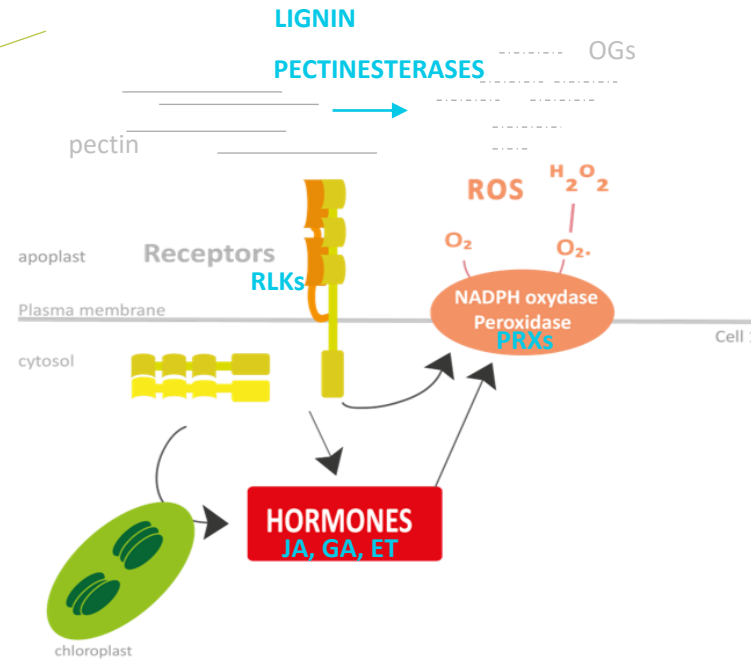


RLKs: Receptor-like kinases

Onset of senescence

Molecular components mis-regulated in '- omics' data

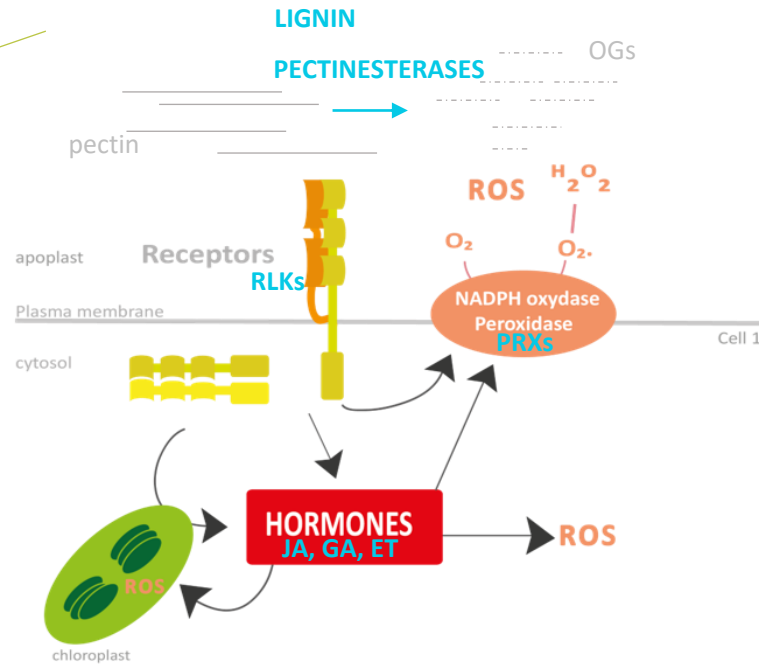
Cellular and molecular control of leaf senescence



RLKs: Receptor-like kinases
 PRXs: Peroxidases
 JA: Jasmonic acid
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Onset of senescence

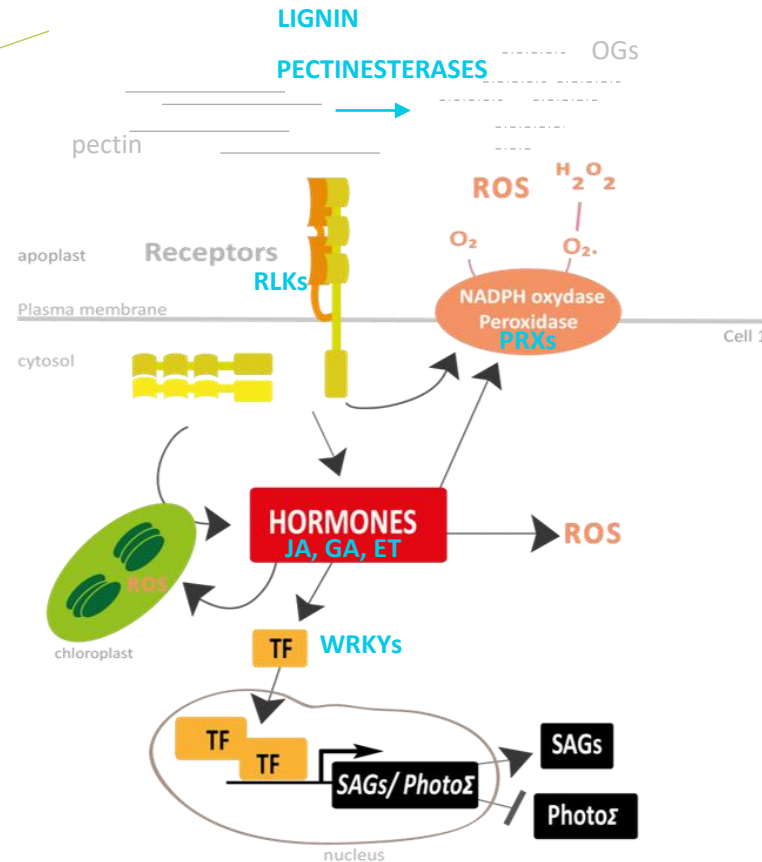
Cellular and molecular control of leaf senescence



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 ROS: Reactive oxygen species

Onset of senescence

Cellular and molecular control of leaf senescence



RLKs: Receptor-like kinases

PRXs: Peroxidases

JA: Jasmonic acid

ET: Ethylene

GA: Gibberellic acid

ROS: Reactive oxygen species

TF: transcription factor

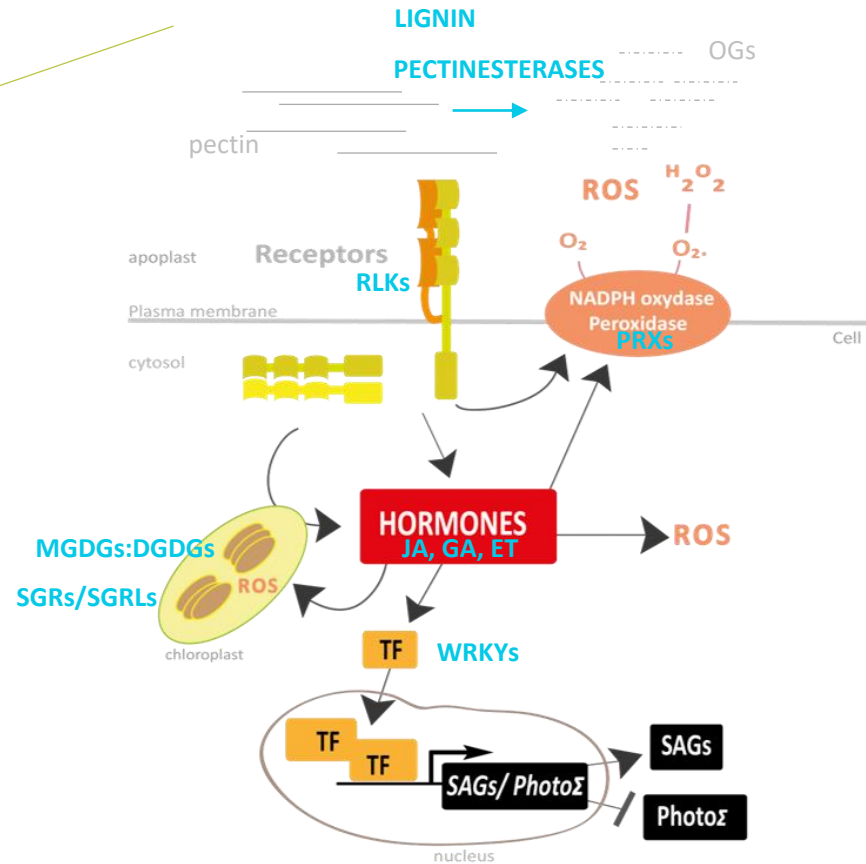
SAGs: Senescence-associated genes

PhotoΣ: Photosynthesis

Onset of senescence

Molecular components mis-regulated in '- omics' data

Cellular and molecular control of leaf senescence

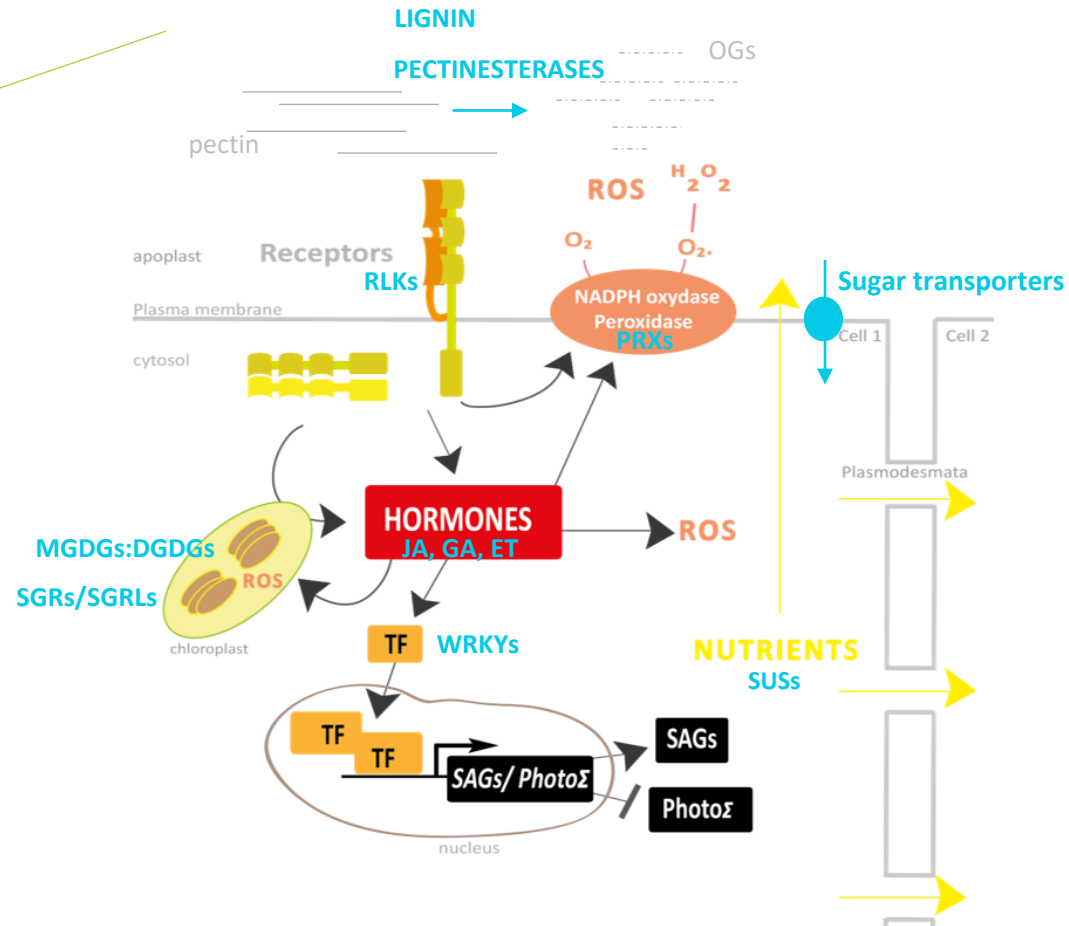


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 JA: Jasmonic acid
 ET: Ethylene
 GA: Gibberellic acid
 ROS: Reactive oxygen species
 TF: transcription factor
 SAGs: Senescence-associated genes
 PhotoΣ: Photosynthesis
 MGDGs: Monogalactosyldiacylglycerols
 DGDGs: Digalactosyldiacylglycerols
 SGRs: Stay-green
 SGRLs: Stay-green-like

Onset of senescence

Molecular components mis-regulated in '- omics' data

Cellular and molecular control of leaf senescence

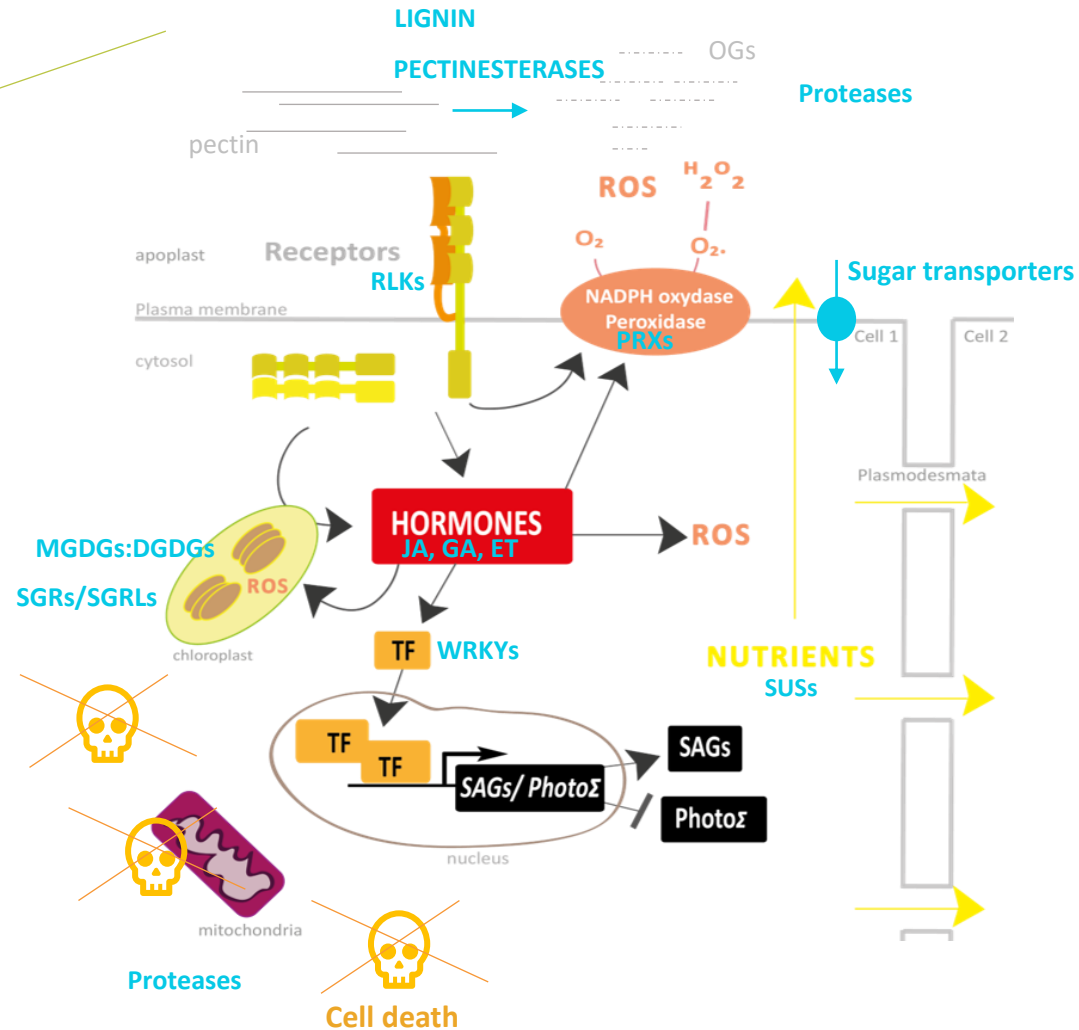


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 SGRLs: Stay-green-like
 SUSs: Sucrose synthases

Re-organisation phase

Molecular components mis-regulated in '- omics' data

Cellular and molecular control of leaf senescence



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 SUSs: Sucrose synthases

Terminal phase

Molecular components mis-regulated in '- omics' data

Ongoing research

Do these molecular components participate in the ripening of leaves?

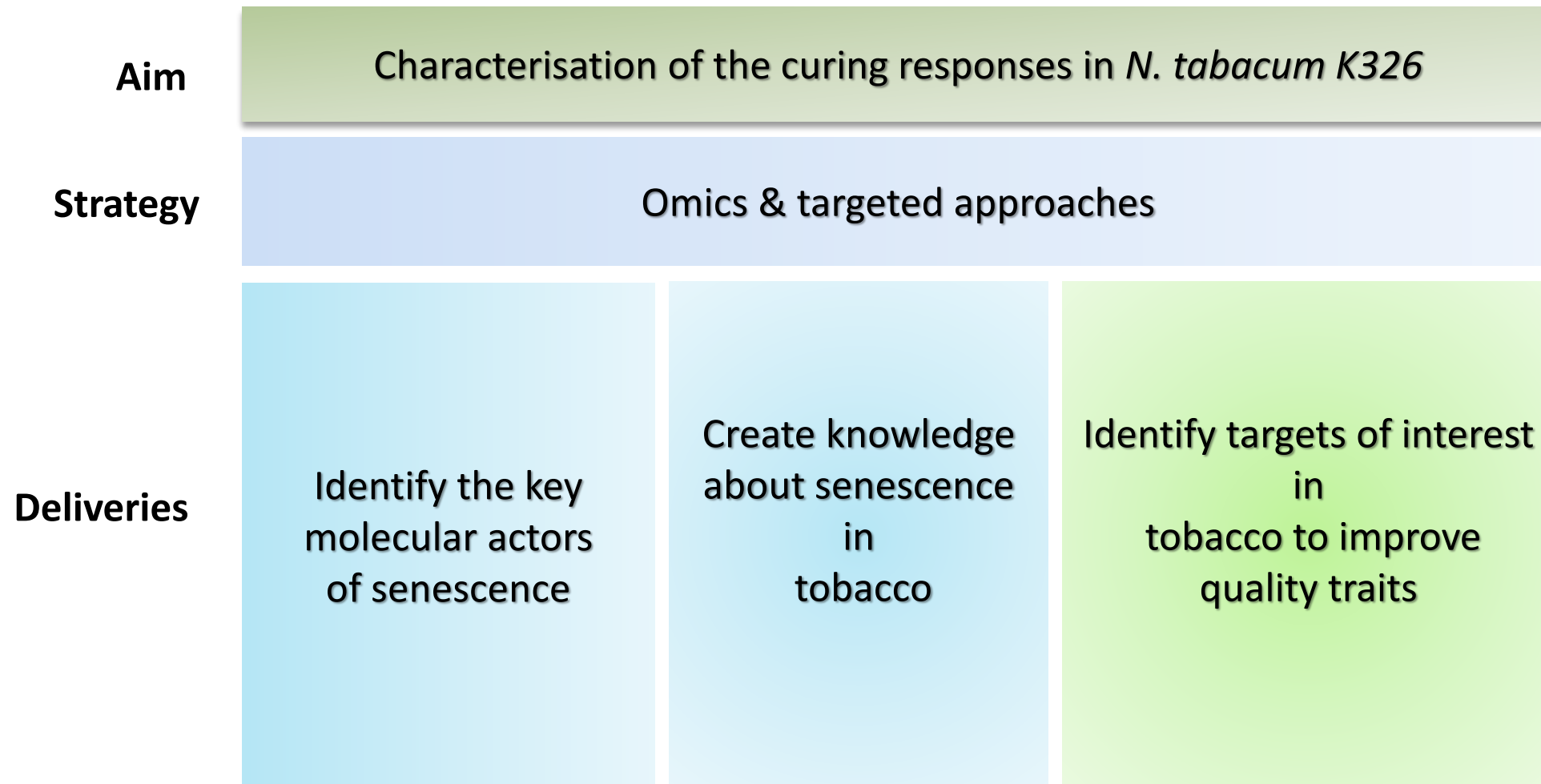
Sampling of *N. tabacum* K326 leaves 5 weeks before maturity



Gene expression & protein accumulation: Analysis of the main molecular actors identified in the curing dataset

Genetics: Evaluation of the importance of these components for maturity & curing

Dynamics of molecular leaf senescence processes in cured Virginia tobacco cultivar K326



Thank you for your attention

Thanks

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