Plant resistance to insect pests

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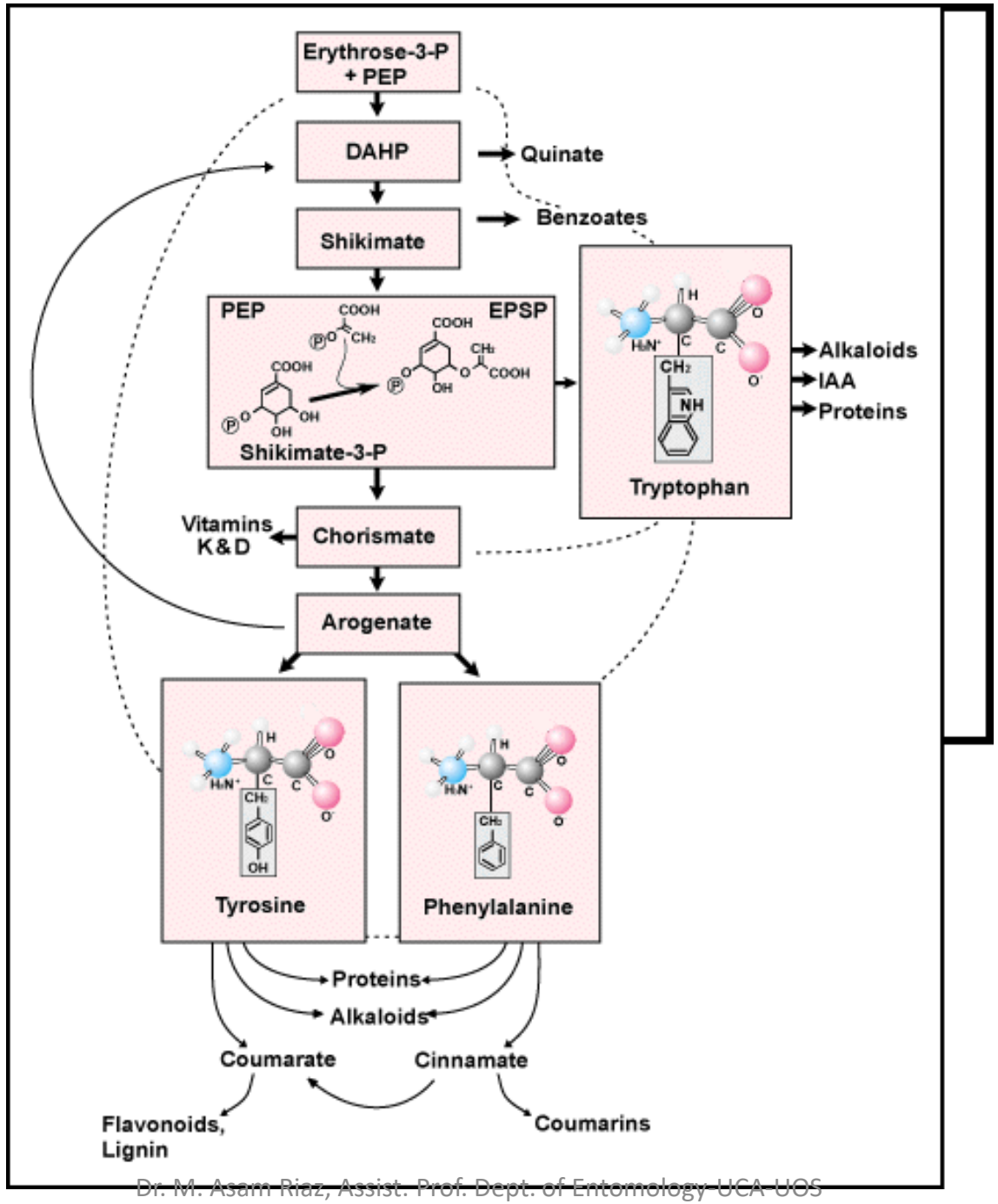
Shikimic acid pathway

- Production of ethylene (Tissue damage or environmental stress)

- Relative activity of Phenylalanine ammonia lyase (PAL)

- Production of phenolics and lignin (as secondary metabolites and causes leaf toughness)

(Karban and Myer 1989)


Erythrose-3-P
+ PEP
DAHP
Quinate
Shikimate
Benzoates
PEP
EPSP
Shikimate-3-P
Tryptophan
Alkaloids
IAA
Proteins
Vitamins
K&D
Chorismate
Arogenate
Tyrosine
Phenylalanine
Proteins
Alkaloids
Coumarate
Cinnamate
Flavonoids,
Lignin
Coumarins

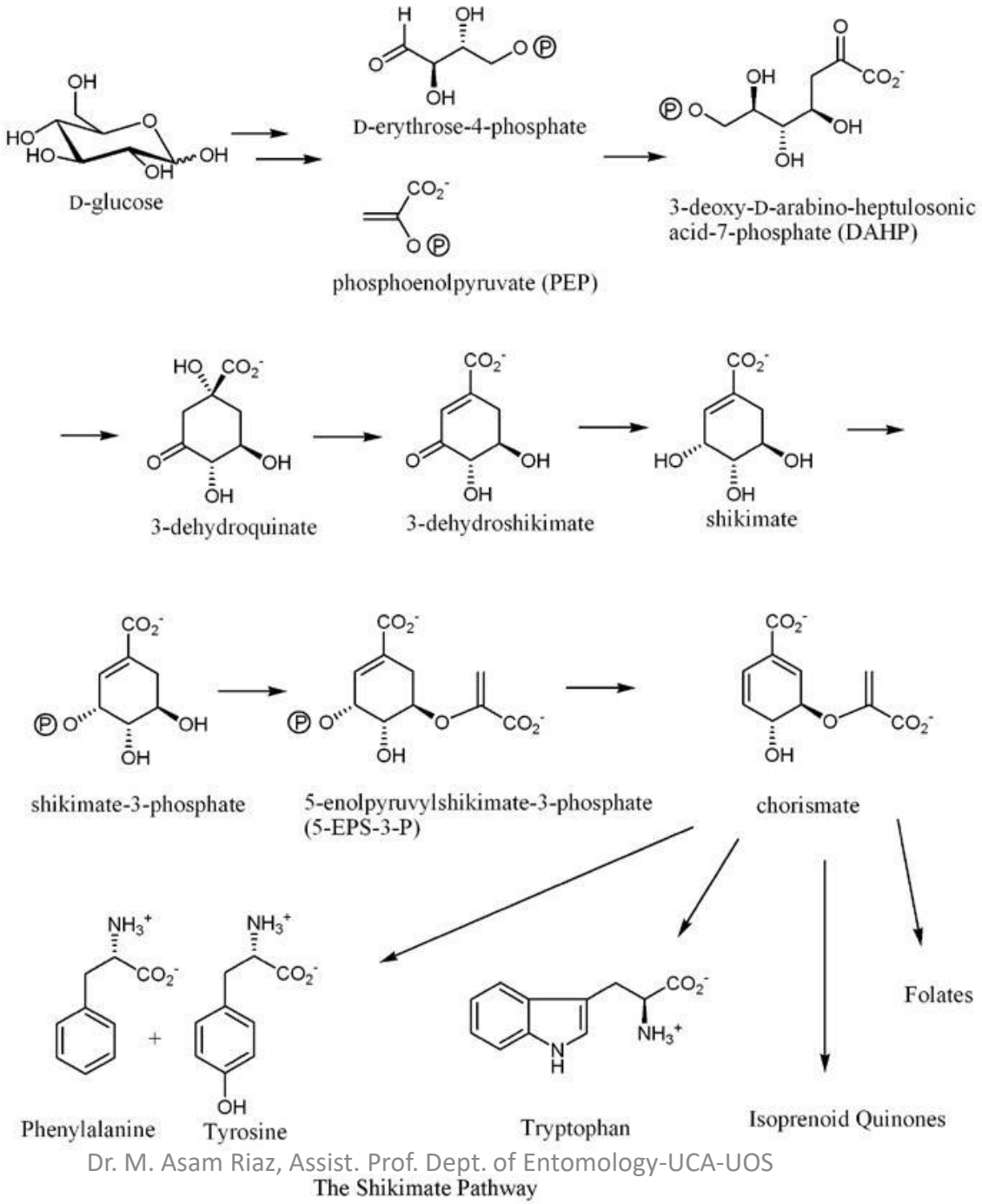
- Phenylalanine and tyrosine are the precursors used in the **phenylpropanoids biosynthesis**.
- The phenylpropanoids are then used to produce the **flavonoids, coumarins, tannins and lignin.**
- The first enzyme involved is **phenylalanine ammonia-lyase (PAL)** that uses L-phenylalanine to products, trans-cinnamic acid and ammonia.

Proteinase inhibitor

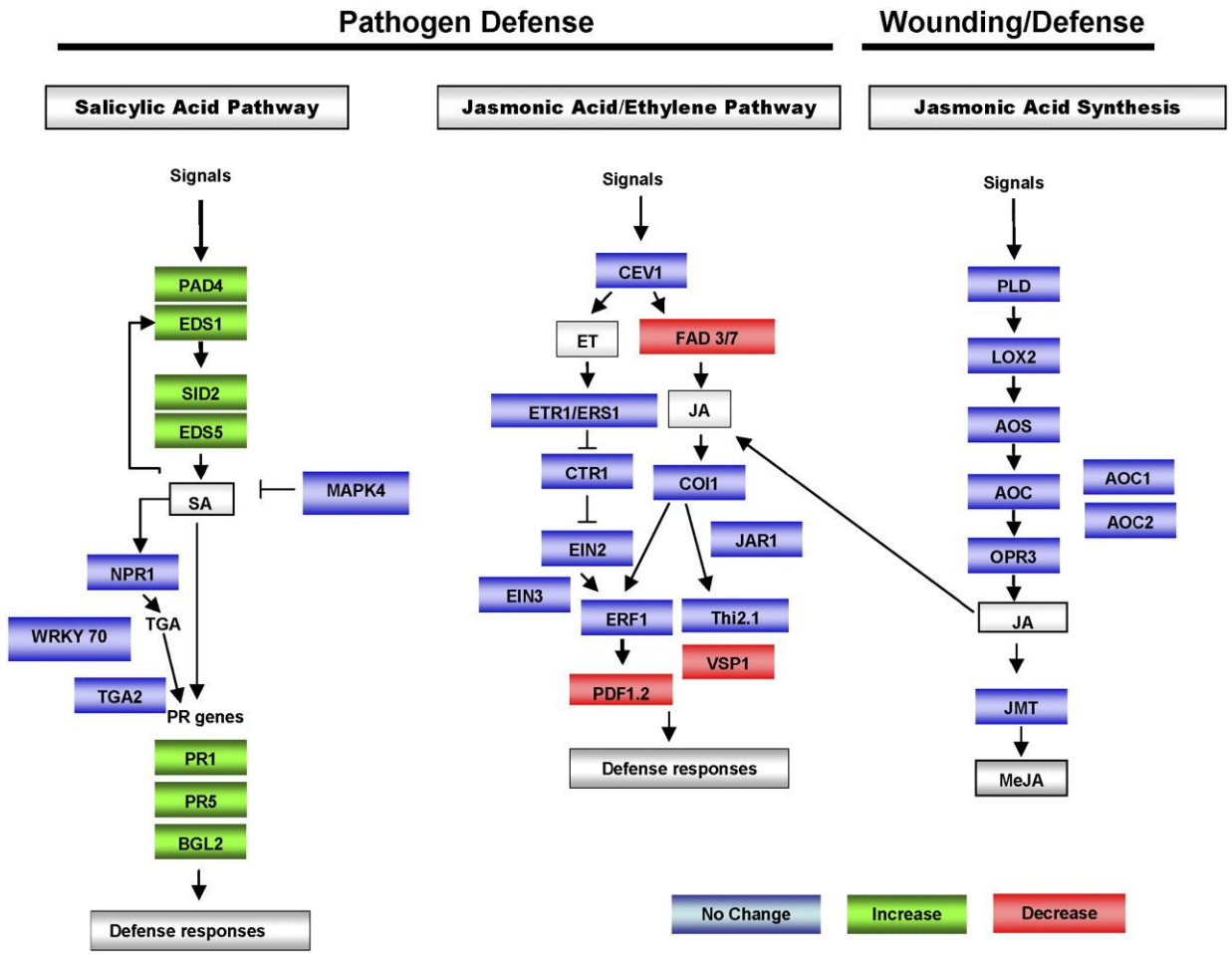
- Damage to tissues may release cell wall fragments that are translocated to other parts of the plant where
- they **activate genes** that code for enzymes, such as **proteinase inhibitors**
- proteinase inhibitors accumulate in vacuoles of **uninjured cells of injured plants** and are deleterious to some caterpillars (10)

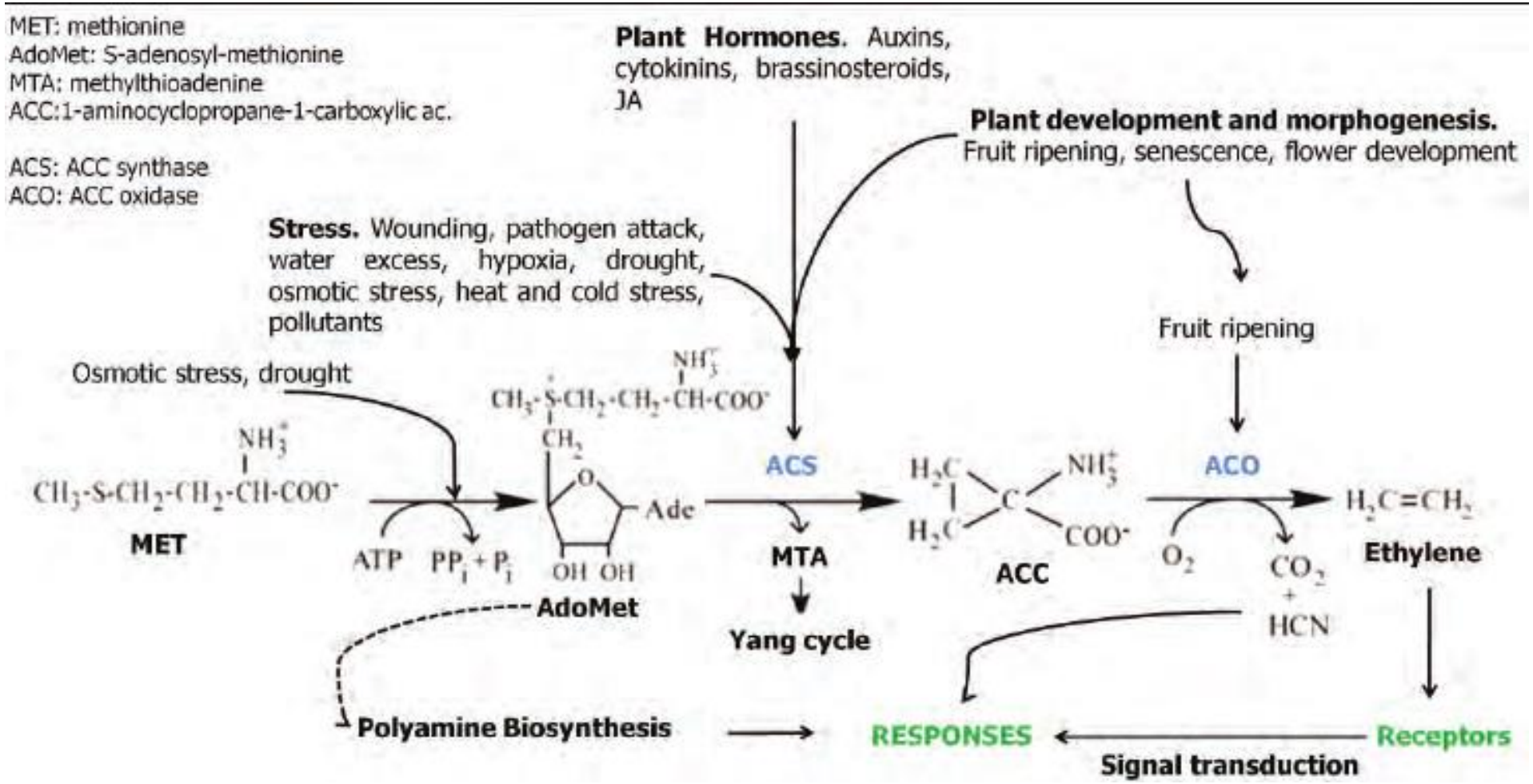
Tradition development of resistant varities

- Plant geneticist, breeders, entomologist
- Role of entomologists
  - Identify the **resistance sources**,
  - characterizing mechanism of resistance,
  - performing laboratory and field assays on resistance
- Identify the **resistance genes** and measure the degree of expression.



The Shikimate Pathway


Pathogen Defense
Wounding/Defense
Salicylic Acid Pathway
Jasmonic Acid/Ethylene Pathway
Jasmonic Acid Synthesis
Signals
PAD4
EDS1
SID2
EDS5
SA
MAPK4
NPR1
TGA
WRKY 70
TGA2
PR genes
PR1
PR5
BGL2
Defense responses
Signals
CEV1
ET
FAD 3/7
ETR1/ERS1
JA
CTR1
COI1
EIN2
JAR1
EIN3
ERF1
Thi2.1
VSP1
PDF1.2
Defense responses
Signals
PLD
LOX2
AOS
AOC
AOC1
AOC2
OPR3
JA
JMT
MeJA
No Change
Increase
Decrease


MET: methionine
AdoMet: S-adenosyl-methionine
MTA: methylthioadenine
ACC:1-aminocyclopropane-1-carboxylic ac.
ACS: ACC synthase
ACO: ACC oxidase
Plant Hormones. Auxins, cytokinins, brassinosteroids, JA
Plant development and morphogenesis.
Fruit ripening, senescence, flower development
Stress. Wounding, pathogen attack, water excess, hypoxia, drought, osmotic stress, heat and cold stress, pollutants
Fruit ripening
Osmotic stress, drought
MET
ATP
AdoMet
ACS
MTA
Yang cycle
ACC
ACO
Ethylene
Polyamine Biosynthesis
RESPONSES
Receptors
Signal transduction

Important abbrevation and definition

- *plant defensin 1.2*, (*PDF1.2*)
- F-box proteins associate with cullin and Skp1 proteins to form an E3 ubiquitin ligase known as the SCF complex (**Bai et al., 1996**).
- **JASMONATE**-ZIM DOMAIN (**JAZ**) repressor proteins
- bioactive jasmonates include 12-oxo-phytodienoic acid (OPDA) and *cis*-jasmone.

Important abbrevation and definition

- The endogenous bioactive JA-Ile conjugate mediates the binding of JAZ proteins to the F-box protein CORONATINE INSENSITIVE1 (COI1), part of the Skp1/Cullin/F-box SCF(COI1) ubiquitin E3 ligase complex.
- Q39204 (MYC2_ARATH) ... Common transcription factor of light, abscisic acid (ABA), and jasmonic acid (JA) signaling pathways.