

Photosynthesis & Pigment Synthesis Inhibitors

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1. Photosynthesis II (PSII) Inhibitors

Uptake & Translocation

Chemistry: Lipophilic – penetrates cuticle

Basic molecules - Xylem mobile only --> Transpiration stream

Mode & Mechanism of action

PSII inhibitors compete with plastoquinone (PQ) at QB binding site of D1 protein

- Blocks electron flow through photosynthesis
- Creation of reactive oxygen species (ROS)
- ROS damage membranes

Resistance <http://www.hracglobal.com/>

HRAC Group 5

Triazines (atrazine, simazine), Triazinones, Triazolinones, Uracils, Pyridazinones, Phenyl-carbamates

HRAC Group 6

Nitriles (bromoxynil), benzothiadiazinones, phenyl-pyridazines

HRAC Group 7

Ureas (diuron), Amides

Resistance: Known mechanisms

Target site resistance: Mutation does not favor binding

Metabolism: Less common - Crop tolerance & selectivity

Symptomology

- Soil Applied Symptoms: Initial injury = first photosynthetic leaves
Chlorosis leaf margins & older leaves
- Foliar Applied Symptoms: Chlorosis & necrosis at leaf tips, older leaves first
- Injury and carryover: greater with late application, dry season, & soil pH >7.2



2. Pigment synthesis Inhibitors

Mode of action

- Depletion of antioxidants (plant protective pigments)
- Increases damage from reactive oxygen (ROS)
- Damages membranes & cellular compartments

Uptake & translocation

- Weak acids: Penetrate cuticle - Phloem-trapped
- Translocated through phloem to new tissues

Mechanism of action

- HPPD inhibitors: Depletes tocopherols, carotenoids, & plastoquinone
- 1-deoxyxylulose-5-phosphate synthase (DOXP5) inhibitors: Deplete carotenoids & plastoquinone
- Phytoene desaturase (PDS) inhibitor: Depletes carotenoids
- Lycopene cyclase inhibitor: Depletes carotenoids

PSII Inhibitors

Photosynthesis review

- Photosystem II (PSII) – first site to accept light energy
- Energy from light drives electron (e⁻) transfer
- Plastoquinone used to carry electrons to next protein (Cytochrome B₆f)

Buchanan, 2000

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Buchanan, 2000

PSII Inhibitors

Mechanism of action

- PSII inhibitors compete with plastoquinone (PQ) at Q_B binding site of D1 protein
- Blocks electron transfer through photosynthesis

Buchanan, 2000

PSII Inhibitors

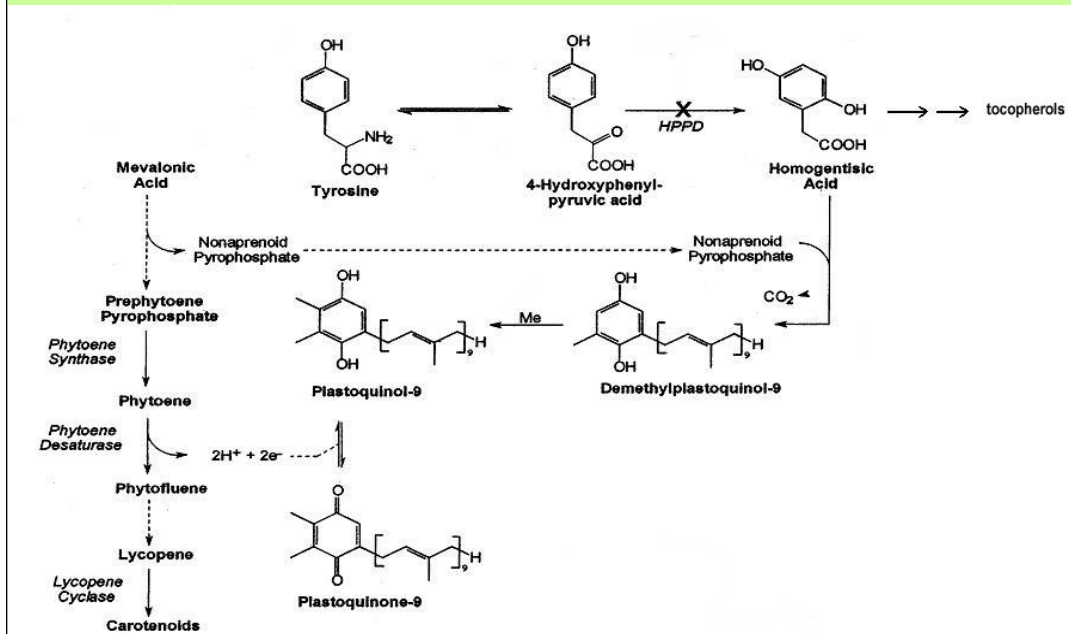
Mechanism of action

- Compete with plastoquinone (PQ) as an e⁻ acceptor at Q_B binding site of D1 protein
- Blocks electron transfer through photosynthesis
- Generates reactive oxygen species (ROS)
- ROS damage cell walls
- Antioxidants
 - partial ROS protection
 - (tocopherols (Vit. E), carotenoids)

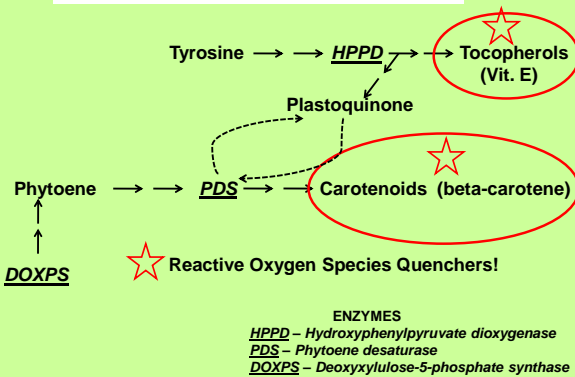
Buchanan, 2000

Pigment synthesis Inhibitors

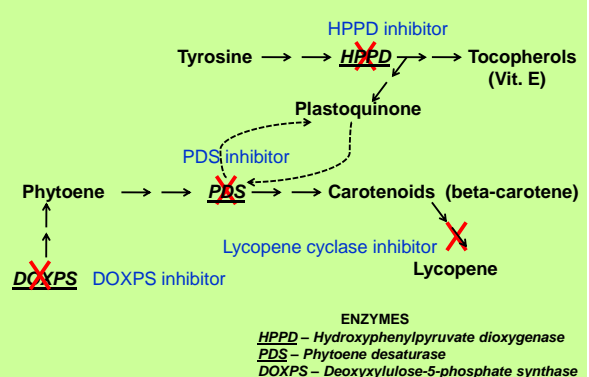
A QUICK BIOCHEMISTRY LESSON



Pigment synthesis Inhibitors



Pigment synthesis Inhibitors



Resistance

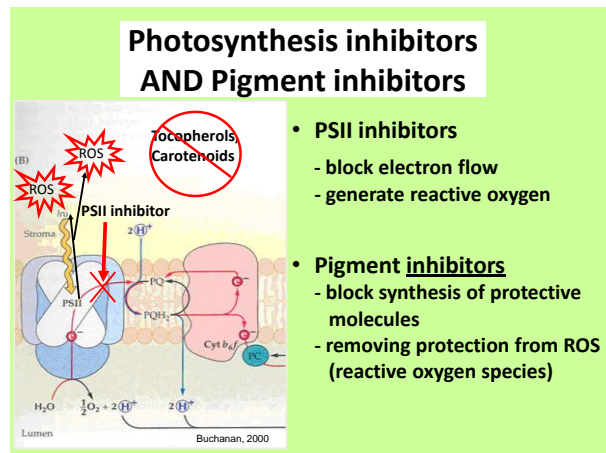
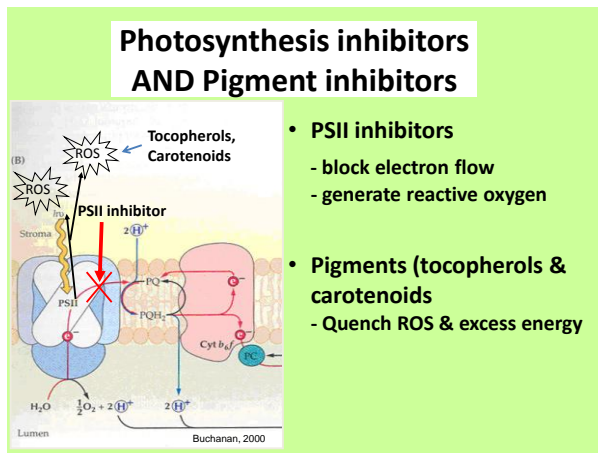
- HRAC Group 11 (*lycopene cyclase*)
Triazoles (amitrole)
- HRAC Group 12 (*phytoene desaturase*)
Pyridazinones (norflurazon), pyridinecarboxamides, 'other' - fluridone
- HRAC Group 13 (*unknown*)
Isoxizolidinones (DOXP synthase inhibitor), Ureas, Diphenyl ethers
- HRAC Group 27 (*HPPD*)
Triketones (mesotrione), isoxazoles, pyrazoles



Symptomology

- New tissue chlorotic or white
- Bleached tissue - necrotic

3. Interaction of PSII & Pigment inhibitors



4. Summary

- **Photosystem II (PSII) inhibitors**
 - Xylem mobile
 - Block electron transfer
 - Reactive species generation
 - Necrosis on leaf margins, older leaves
- **Pigment synthesis inhibitors**
 - Phloem mobile
 - Block antioxidant synthesis
 - Increased Reactive Oxygen Species damage
 - Chlorotic or bleached young tissue