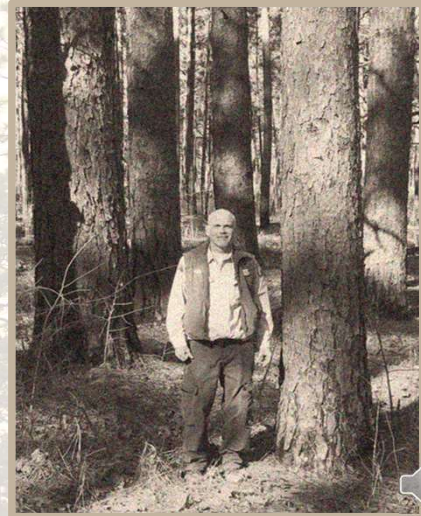


Herbicides in Forestry : Part 2

How do Herbicides Work?

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 N C Forest Service - Retired
bpickens827@gmail.com



1

How Do Herbicides Work?

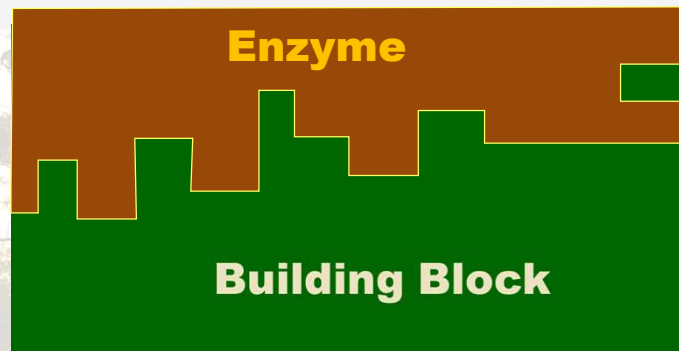
- ✓ Various "Modes of Action"
- ✓ Mobility
 - In the plant
 - In the environment



2

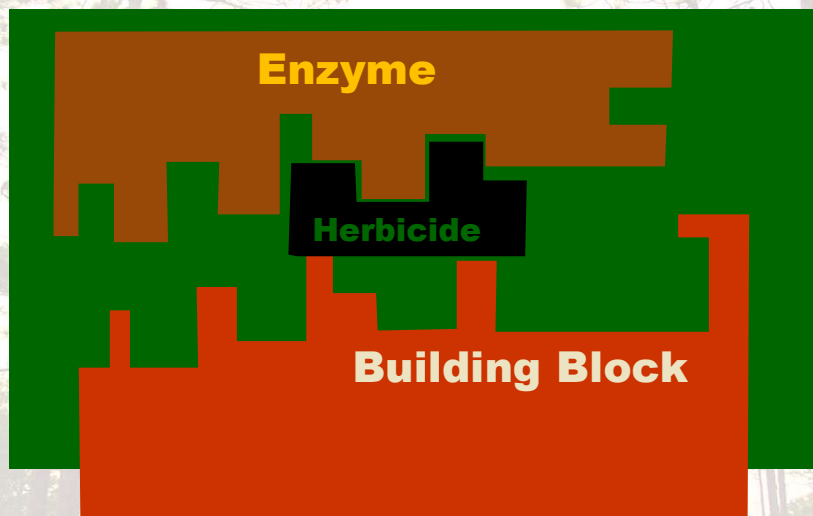
Herbicide Modes of Action

- ✓ Disrupt one or more vital processes
 - Highly specific



3

Herbicides Mode of Action



4

Herbicide Modes of Action

- ✓ Auxin mimics
 - Garlon, 2,4-D, Milestone
- ✓ Amino acid inhibitors
 - Accord, Arsenal
- ✓ Photosynthesis inhibitors
 - Velpar
- ✓ Protoporphyrinogen-oxidase Inhibitor
 - Detail



5

Herbicide Modes of Action

- ✓ Mitosis inhibitors (mersitems)
 - Krenite
- ✓ Cell membrane destroyers
 - Paraquat
- ✓ Lipid biosynthesis inhibitors
 - Poast, Vantage, Fusilade
- ✓ Cellulose biosynthesis inhibitor
 - Esplande F



6

Behavior in Plants - Consider:

- Site of Absorption Into Plant
- Translocation Within the Plant
- Site of Physiological Action
- Symptoms, Fast vs. Slow

7

Inhibitors of Amino Acid Synthesis

Common Name	Trade Name
Glyphosate	Accord® Roundup® <i>Many Others</i>
Imazapyr Imazapic	Arsenal® Plateau®
Sulfometuron methyl Metsulfuron methyl	Oust® <i>Escort®</i>

8

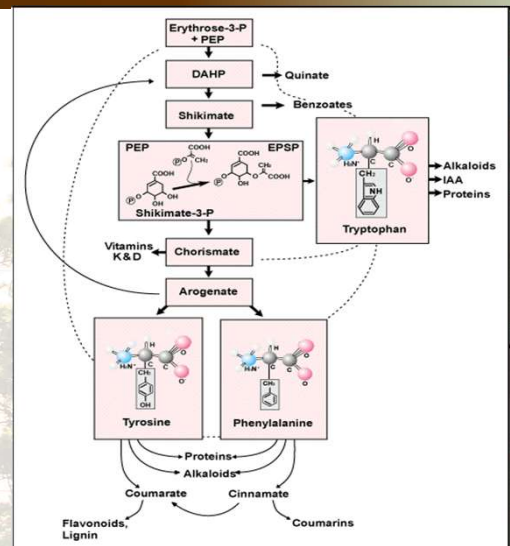
Glyphosate: Absorption and Translocation

- Absorption is through the foliage. Limited soil in sandy sites
- Strongly adsorbed by soil.
- Primarily translocated in the phloem and within the symplasm.
- Glyphosate accumulates in underground tissues, immature leaves, and meristems.

9

Glyphosate: Mode of Action

- Inhibits the formation of aromatic amino acids (tryptophan, tyrosine, and phenylalanine).
- *Having a very specific site of action facilitates development of herbicide resistance.*



10

Glyphosate -*Accord, Roundup, One Step*

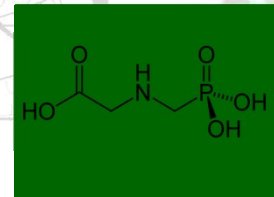
- ✓ Non-selective herbicide
- ✓ Foliar applications only
- ✓ Symptoms first evident on new growth
 - Pigment loss
 - Growth stoppage
 - Distorted growth
- ✓ Fast symptoms, slow death



11

Glyphosate -*Accord, Roundup, One Step*

- ✓ Deactivated by soil, dust
- ✓ Post emergent
- ✓ Non-Persistent –does not leach
- ✓ Absorbed by green tissues only
- ✓ Can volatilize on hot days!



12

Imazapyr - Absorption and Translocation

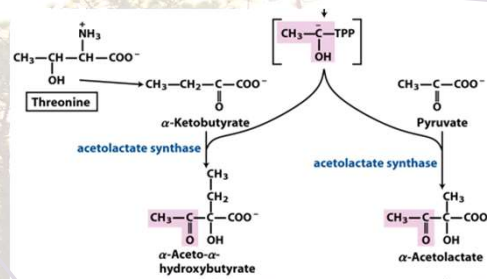
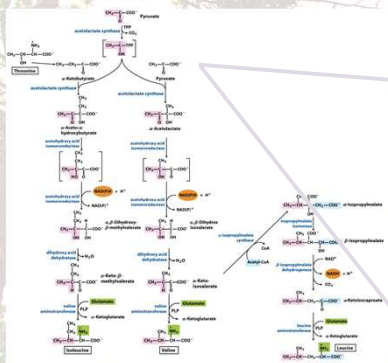
- **Absorption**
 - Absorbed through roots and foliage
- **Translocation**
 - Rapid translocation throughout the plant through the xylem and phloem.
 - Accumulates in symplasm through ion-trapping mechanism.



13

Imazapyr – Arsenal, Chopper, Polaris

- ✓ Amino acid inhibitor (branched chain)



- ✓ Isoleucine, Leucine, and Valine are not produced



14

Imazapyr – Arsenal, Chopper, Polaris

- ✓ Non-selective --(but tolerated by some conifers)
- ✓ Post Emergent
- ✓ Control -- broad range of grasses, broadleaved herbs, and woody species
- ✓ Persistent -- Average soil half life is 25-141 days



15

Imazapyr - Symptoms

- Growth is inhibited after a few hours
- Symptoms are very slow to develop; 1-3 weeks in herbaceous plants to several months in woody plants.
- Symptoms first occur in growing points as yellowing then progressing to necrosis.



16

Imazapyr – Arsenal AC, Chopper, Polaris

- ✓ Below pH of 5, dry conditions, low temps
 - Binds to clay and organic matter
 - Very persistent in soil
 - Stable in soil for more than a year at normal temperatures
- ✓ Above pH of 5
 - It may leach from soil
 - more available to the plant
 - Degradation is slowed



17



18

Tankmixes work on more plants

What Makes Imazapyr + Glyphosate so Popular?

THE "MIX" INHIBITS THE SYNTHESIS OF 6 OUT OF 7 ESSENTIAL PLANT AMINO ACIDS.

ACCORD
TRYPTOPHAN
PHENYLALANINE
TYROSINE

ARSENAL
APPLICATORS CONCENTRATE
LEUCINE
ISOLEUCINE
VALINE

ACCORD/ARSENAL APPLICATORS CONCENTRATE
ONE-TWO PUNCH

ACCORD
Elm
Blackberry
Cherry
Residual pine

ARSENAL
Box elder
Hickory
Maple
Blackgum
Sweetgum
Oak
Poplar
Dogwood
Sourwood

19

Growth Regulators

Common Name	Trade Name
2,4-D, 2,4-DP	Weedone® <i>many others</i>
Triclopyr	Garlon®
Clopyralid	Transline®
Aminopyralid	Milestone®

20

Growth Regulators: Translocation

- All translocate via the xylem and phloem, but most movement is in the phloem and cell-to cell – the symplasm membranes
- All accumulate in growing points



21

Growth Regulators: MOA

- **Auxin overdose**
 - Many processes affected.
 - Not completely understood.
 - The specific site of action has not been identified.
- Primarily effects cell wall plasticity and nucleic acid metabolism. Cell wall is acidified and elongated



22

Growth Regulators: Symptoms

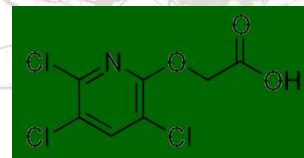
- Epinastic bending and twisting, stem swelling and elongation, and leaf cupping and curling
- Chlorosis of growing points, growth inhibition, wilting, and necrosis.
- Death of susceptible plants occurs within 3-5 weeks.
- In woody plants **rapid necrosis of foliage may reduce effectiveness** of translocating herbicides.



23

Triclopyr – Garlon, Pathfinder

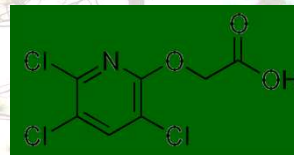
- ✓ Auxin Growth Regulator
- ✓ Should not contact pine foliage, directed applications only, may cause temporary injury



24

Triclopyr – Garlon, Pathfinder

- ✓ Selective --effective against broad leaf species only, not grasses
- ✓ Rapidly taken up by roots and leaves and transported to growing tissues



25

Triclopyr – Garlon, Pathfinder

- ✓ Volatile, high danger of drift
- ✓ In the soil, it is rapidly deactivated, but does not bind to soil particles
- ✓ Usually degrades in 30 days



26

Photosynthesis Inhibitors

Common Name	Trade Name
Hexazinone	Velpar®
Atrazine	Aatrex® <i>Others</i>

27

Hexazinone : Absorption and Translocation

- Absorbed through roots with soil applications and translocated upward through xylem
- Absorbed through leaves following foliar applications but poorly translocated to other plant parts

28

Hexazinone - MOA and Symptoms

- **Photosynthesis inhibitor:** Inhibits electron transport in photosystem II
- Symptoms begin with chlorosis and yellowing of leaf margins and progress to necrosis.
- Older leaves show more symptoms than new growth



29

Oust & Escort

- **Absorption**
 - Readily absorbed by leaves following post treatments and by roots from treated soil.
- **Translocation**
 - Move primarily in the xylem and to a limited extent by mass flow in the phloem.
 - Accumulate in meristematic regions of the plant.



30

Oust & Escort - Symptoms

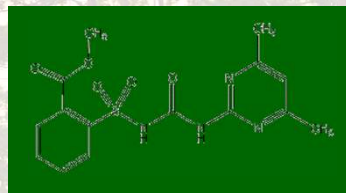
- Growth is inhibited after a few hours but symptoms are very slow to develop; 2-3 weeks in herbaceous plants to several months in woody plants.
- Symptoms gradually appear as chlorosis in growing points then progress to chlorosis and necrosis of the foliage.



31

Sulfometuron Methyl - OUST

- ✓ Pre-emergent
- ✓ Persistent
- ✓ Most effective against grasses and broadleaf weeds in early stages of growth



32

Sulfometuron Methyl - OUST

- ✓ Persistent at soil pH > 6.8
- ✓ Cold dry conditions after application slow activity
- ✓ Leaches out of soils, especially at higher pHs
- ✓ Usually short-lived in the soil, but persistence has been observed under some conditions (2+ years)

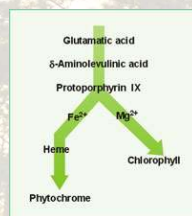


33

Detail (saflufenacil) & Milestone (aminopyralid)

Detail

- Protoporphyrinogen-oxidase Inhibitor
- Post emergent –root and shoot absorbed
- Selective broad spectrum
- Quick brown-up
- Synergistic with glyphosate
- Wildling Pine Control
- Site Prep



Milestone

- Auxin mimic growth regulator
- Pre and post emergent
- Selective broad spectrum control
- Wildling Pine Control – but not LL
- Environmentally safe
- Site Prep and HWC



34

Esplande F – (indaziflam)

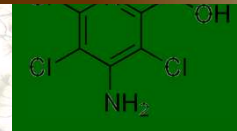
- Cellulose Biosynthesis inhibitor – unique MOA
- Preemergent - Soil active
- Selective broad spectrum weed control
- Not LL or most perennial grasses
- Safe over LL – “excellent tree safety”



35

Picloram – Pathway, Tordon

- ✓ Auxin Growth Regulator
- ✓ Effective against broad leaf species only, not grasses
- ✓ Taken up readily by roots, less so by foliage



36

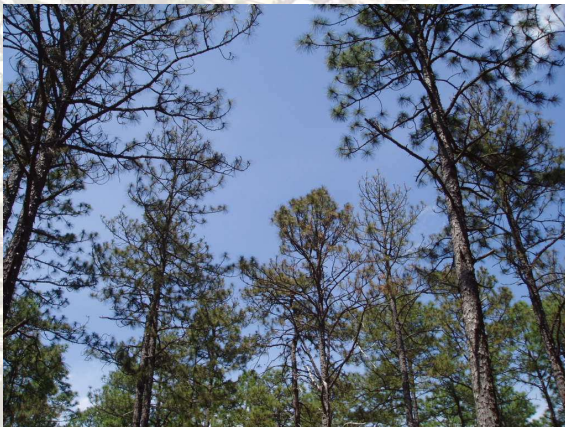
Picloram – Pathway, Tordon

- ✓ May leach from roots of treated plants
- ✓ Readily leaches out of soil, but may bind to organic matter
- ✓ Usually persists in soil for less than 3 months, but organic matter and/or dry conditions drastically increases half-life (3+ years)
- ✓ Toxic to pines, especially when stressed



37

Picloram damage



Canopy thinning due to herbicide damage



38

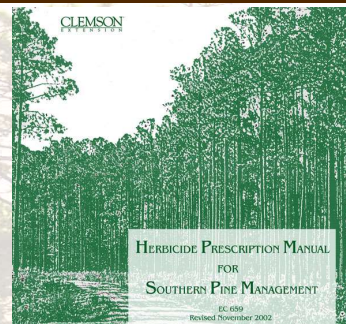
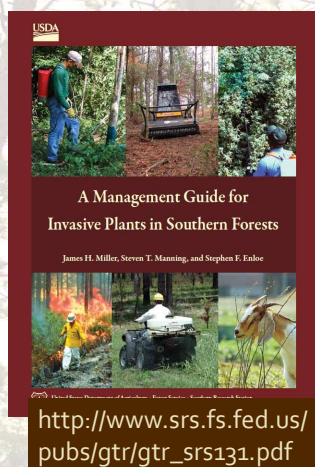
Source of Information

- Herbicide Handbook. 2002. S.A. Senseman, Ed., Ninth Edition, Weed Science Society of America, 810 E. 10th Street, Lawrence, KS 66044-8897. (ISBN 1-891276-56-5)
- Osiecka, A. and P. Minogue. 2011. Forest herbicide characteristics. University of Florida Cooperative Extension Service Circular FOR 283. 9 pp. <http://edis.ifas.ufl.edu/fr345>
- Osiecka, A. and P. Minogue. 2010. Developing herbicide prescriptions for forest vegetation management. University of Florida Cooperative Extension Service Circular FOR 273. 8 pp. <http://edis.ifas.ufl.edu/fr335>



39

Excellent Resources



<http://www.clemson.edu/extfor/herbicide%20prescription%20manual/herbicidemanual.htm>



40

Read and follow the label!! Questions?

