THE UNIVERSITY OF ARIZONA

Post-Directed Herbicide Options in Cotton

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2004 Cotton Herbicides by Target Weed

Grasses

Preemergence: Pendimax, Prowl, Prowl H_2O, Treflan, trifluralin

Postemergence: Poast, Fusilade, Select, glyphosate, DSMA, Ignite, MSMA

Broadleaves

Preemergence: Prowl, Treflan, diuron* (Karmex), prometryn (Caparol), Zorial* Rapid 80 (*do not use PPI if dry planting cotton)

Postemergence: Aim, Buctril, Chateau, Cotoran (fluometuron), diuron, DSMA, Envoke, ET, glyphosate herbicides (e.g., Glyphomax, Glyphos, Glyphosate Original, Roundup Ultramax, Touchdown IQ), Goal, Ignite, MSMA, prometryn, Staple, Suprend

Nutsedges

Preemergence: Zorial Rapid 80, Dual Magnum (yellow only)

Postemergence: DSMA, Envoke, glyphosate herbicides, Ignite (suppression), MSMA

Early Season Weed Control

- Goal: obtain height differential between cotton and weeds.
  - Preplant/preemergence herbicides (Prowl, trifluralin)
  - Topical (over-the-top) herbicides
    - RR/Glyphosate (Roundup, Touchdown, generics)
    - Conventional/Staple
    - Liberty Link/Ignite

Early Season Postemergence Herbicide Options: Cotton Up To 6 Inches Tall

- Roundup Ready cotton varieties (topical through 4th lf)
  - Glyphosate @ 0.75 lb ae/A (salvage 1.17 lb ae/A)
- All cotton varieties (0 to 6")
  - Topical
    - Staple @ 1.5 to 1.8 oz/A (1.2 to 1.5 oz a.i./A) + NIS
  - Sloppy Post-direct:
    - Envoke @ 0.1-0.15 oz/A (0.0047-0.007 lb ai/A) + NIS after cotton has 5 true leaves
    - MSMA @ 2.7 pt/A (2 lb a.i./A) + NIS
    - Liberty Link Cotton – Fibermax cotton varieties
  - Ignite @ 40 oz/A (0.417 to 0.52 lb ai/A) + AMS + NIS
- BXN cotton varieties - Buctril @ 0.5 to 1.0 lb a.i./A

Early Season Weed Competition, Salvage Operations & Yield Reductions

Desired Result From Early Season Herbicide Applications

Mid-Season Post-Directed Herbicide Options: Cotton 6 To 12 Inches Tall

- All cotton varieties (6" to 12")
  - Diuron* 0.8 pt/A (0.4 lb ai/A) + NIS
  - Envoke 0.15-0.25 oz/A (0.0047-0.007 lb ai/A) + NIS
  - Goal* 1-2 pt/A (0.25 to 0.5 lb ai/A) + NIS
    - (Aim, Chateau, ET - more restrictive labels, hoods)
  - MSMA @ 2.7 pt/A (2 lb ai/A)+NIS (usually a tank-mix partner)
  - Prometryn* 1 pt/A (0.5 lb ai/A) + NIS
  - Staple @ 1.5-1.8 oz/A (1.2 to 1.5 oz ai/A) + NIS
- Tank Mixes
  - Glyphosate 0.75 lb ae/A (RR), Ignite 40 oz/A (Liberty Cotton)

*Non-selective "Chemical Hoe" herbicides – Accurate post-directed spray application or the use of hoods (e.g., Redball 410 & 420 hoods) and shields is necessary to avoid cotton injury.

Accurate Post-Directed Herbicide Applications

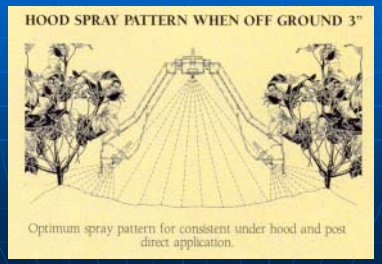
- Crop injury can be avoided by partially blocking postemergence herbicides from contacting crop foliage and accurately post-directing herbicide sprays.
- Example of post-directed herbicide applications in an annual row crop using a Redball 420 hood.

Streamlined design of the Spray-Hoods allow them to glide gently between crop rows. This limits contact with crop and provides for faster travel speeds.

Center skid is adjustable to set hood height which allows the hood to follow ground contours.

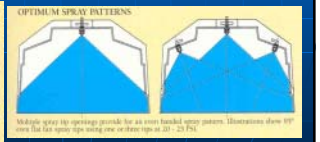
Accurate Post-Directed Herbicide Applications

- Nozzle arrangement in the Redball 420 hood.



Accurate Post-Directed Herbicide Applications

- Avoiding crop injury by using hoods to totally block postemergence herbicides from contacting crop foliage.
- Example of in-furrow postemergence herbicide applications in an annual row crop using a Redball 410 conservation tillage hood.

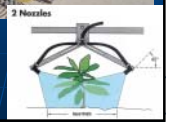


Hooded sprayer in no-till cotton planted into barley stubble

Post-Direct Nozzles on Hooded Sprayer

Compressed Air Plot Sprayer

- Sprayer equipped with gauge wheels to allow accurate height control of broadcast boom and post-direct boom.
- Gauge wheels also cause the sprayer to track in the bottom of the furrow maintaining nozzle placement with respect to the cotton seed-line.
- Drop tubes with single swivels spaced 6 to 12 inches from crop row can be used to post-direct herbicides.



Post-directed and Layby Herbicide Options: Cotton 12 to 24 Inches Tall or Greater

Herbicide (add adjuvants)	Soil Texture
Aim – 1 to 1.6 oz/A	no soil activity
Chateau – 2 oz/A	all, moderate activity
Diuron – 0.8 to 1.6 qt/A	coarse and medium
ET – 1 to 2 oz/A	no soil activity
Prometryn - 0.8 to 1.6 qt/A	coarse and medium
Goal – 1qt/A	all soil types
Suprend – 1 to 1.5 lb/A (0.98 prometryn + 0.00875 trifloxysulfuron)	coarse and medium

- Tank mixes
  - Prowl - after last cultivation
  - PPO inhibitors + either prometryn or diuron
  - RR/glyphosate (e.g. grasses, nutsedges or large weeds) or Liberty cotton/Ignite
- Consider layby herbicide-crop rotation restrictions

Topical Roundup @1.17 lb ae/A+AMS followed by Touchdown @ 0.75 lb ae/A at the 12 in tall growth stage of cotton

Topical Roundup @1.17 lb ae/A+AMS followed by Aim @ 0.016 lb ai/A +1 % COC at 12 in tall cotton

Topical Roundup @1.17 lb ae/A+AMS followed by Aim @ 0.016 lb ai/A +1 % COC at 12 in tall cotton

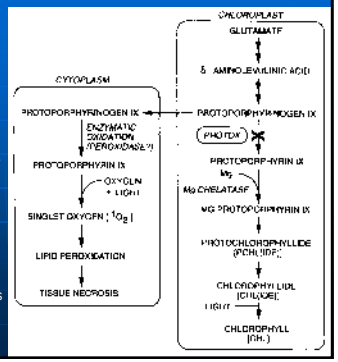
Topical Roundup @1.17 lb ae/A+AMS followed by Chateau @ 0.031 lb ai/A + Roundup @0.75 lb ae/A + AMS at the 12 in tall growth stage of cotton

Herbicide Mechanisms Dependent on Light That Cause Lipid Peroxidation.

- 1. Herbicides that inhibit/destroy carotenoid pigments
  - e.g., norflurazon, fluridone, clomozone, and isoxaflutole
- 2. Herbicides that inhibit electron (e-) flow in photosystem II
  - e.g., triazines, phenylureas, hydroxybenzonitriles and uracils
- 3. Herbicides that capture electrons (e-) from photosystem I
  - e.g., paraquat and diquat
- 4. Herbicides that affect chlorophyll biosynthesis through protoporphyrinogin IX (inhibition of chlorophyll synthesis and concentration increase in toxic precursor).
  - e.g., oxyfluorfen (Goal), lactofen (Cobra), flumioxazin (Chateau), carfentrazone (Aim), sulfentrazone (Authority), pyraflufen ethyl (ET)
- 5. Herbicide that inhibits glutamine synthetase in nitrogen assimilation.
  - e.g., glufosinate (Ignite)

Chlorophyll Biosynthesis Inhibitors

- A large group of herbicides inhibits protoporphyrinogen oxidase in the chlorophyll biosynthesis pathway.
- Susceptible plants accumulate toxic levels of protoporphyrinogen IX which reacts with oxygen in light to form singlet oxygen.
- Singlet oxygen causes rapid lipid peroxidation.



Protox Inhibitors

- Protoporphyrinogen oxidase inhibitors (Protox inhibitors) cause localized, contact symptoms in plants.

Untreated

Oxyfluorfen (Goal) on beans

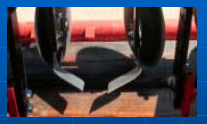
Protox Inhibitors

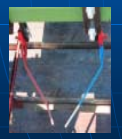
- Protoporphyrinogen oxidase inhibitors (Protox inhibitors) cause localized, contact symptoms in plants.

Oxyfluorfen (Goal) on privets

Precision Cultivation - Quick Hitch Guidance Systems

Torsion Bar Weeders





In-row Weeding

Before cultivation

After cultivation

Precision Cultivation Adoption

- Precision cultivation demonstrations were conducted in Arizona and several systems were purchased.

Precision Cultivation – Potential Problems

- However, many growers who purchased quick hitch guidance systems are no longer using them.
- Greatest difficulty is with the sensing technology (i.e., the mechanical wand used to sense the location of the crop row.
  - Small cotton (less than 8 to 10 in tall) could not be reliably sensed with a mechanical wand; the cotton was not strong enough to guide the wand.
  - Gaps in the seed row further compounded the problem of sensing where the crop row is located.
- Cotton must be 12 inches tall with bark on the lower stem to use precision cultivation with in-row weeding.

Precision Cultivation – Potential Problems

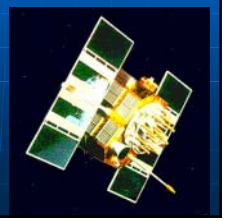
- Precision cultivation cannot be used in crops that don't have woody stems to guide the wand.
- For the greatest benefit, guidance systems should be used for most early season field operations such as listing and planting (but guide furrow difficult to use).
- Generally requires more management to integrate herbicides and precision cultivation.
- Requires a more skilled tractor driver. Employee turnover discourages the use of guidance systems due to the need to train drivers.

Future of Precision Cultivation

- All of the above factors discouraged the use of precision cultivation.
- However, recent advances in computer, optical science and the development of Global Positioning Systems make precision cultivation more practical.
- Herbicide technology has also improved greatly in some crops such as cotton.

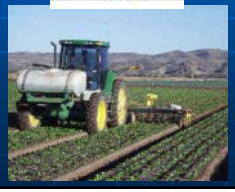
Future of Precision Cultivation

- Differential GPS and centimeter level accuracy using Real-Time Knematic (RTK) can accurately control a tractor/cultivator without mechanical sensing guides.
- A digital camera and optical sensor in ECO-DAN Guidance Systems can also keep a cultivator accurately following a crop seed line without a mechanical sensing element.
- Perhaps time to reinvestigate precision cultivation



Eco-Dan Precision Cultivation






Sample Field Operations

Wet Plant Operation	Dry Plant Operation
flat ground	flat ground
PRE Herbicide & disk	PRE Herbicide & disk
list	list
pre-irrigate	mulch and shape bed
mulch and shape bed	plant
plant	irrigate
topical herbicide: 2-3 lf[1]	topical herbicide: 2 to 3 lf
cultivate	cultivate
irrigate	irrigate
PD herbicide[2]	PD herbicide
cultivation (precision?)[2]	cultivation (precision)[2]
layby herbicide	layby herbicide

- *1-often not necessary in fields with low weed pressure*
- *2-may be able to use precision cultivation and in-row weeding but cotton must be 12 inches tall with bark on the lower stem.*

Future of Precision Cultivation

- The future of precision cultivation partly depends on:
  - Improvements in and cost of competing technologies (e.g., Roundup Ready crop technology).
  - Adoption of no-till, reduced till or conservation tillage practices
    - Greater reliance on chemicals
    - Shift in weed species to more tolerant species
    - Herbicide resistance
  - Cost of tillage in both economic terms (capital in tractors, labor, fuel, etc.) and biological terms
    - PM10 dust