Weed management in sugarcane

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USA sugarcane is cultivated on 354,000 ha in Florida and Louisiana, with limited production in Texas.
Florida sugarcane production

- Sugarcane is cultivated in the Everglades Agricultural Area (EAA) and surrounding region in south Florida
- EAA is comprised of 283,000 ha of land
  - Major crop – sugarcane
  - Other crops – vegetables, rice & commercial sod
- 160,000 ha of sugarcane in Florida in 2016
  - 78% on organic/muck soils (Histosols)
  - 22% on mineral/sandy soils (Spodosols & Entisols)
- There are four sugarcane mills in Florida
EAA organic soils

- EAA is dominated by organic soils underlain by limestone rock layer
- Soils have high soil organic matter content of up to 85%
- Weed control especially with soil applied herbicides is more difficult on these soils because of
  - High cation exchange capacity, large soil microbial populations, and relatively high soil moisture and temperature often associated with herbicide adsorption and metabolism by soil microorganisms
  - These factors combine to promote rapid weed growth while binding or degrading soil-applied herbicides thus significantly reducing their efficacy
Florida sugarcane crop cycle

- Planting season: September to December
- Harvest season: mid-October to March/April
- Planting and harvesting coincides with dry season
- Planting done either
  - Following fallow period
    - Temporary rotation with different crops following final ratoon
      - Sweet corn, rice, radish, green bean, leafy green vegetables
      - Long sugarcane production cycle in combination with rotation with grass crops results in heavy pressure of mostly annual and perennial grasses
  - Successive
    - Replanting several weeks after final ratoon
      - Not recommended in fields with heavy grass pressure especially perennial grasses
Weeds in Florida sugarcane

- **Florida** → burning fields prior harvest → no straw → mostly grasses and small seeded broadleaf weeds

- **Brazil** → green harvesting → more straw → less grasses → mostly large seeded broadleaf weeds
Weeds in Florida sugarcane

Grasses
Most prevalent
• *Panicum dichotomiflorum*
• *Cynodon dactylon*

Others
• *Eleusine indica*
• *Digitaria ciliaris*
• *Digitaria ischaemum*
• *Dactyloctenium aegyptium*
• *Sorghum almum*
• *Pennisetum purpureum*
• *Panicum repens*

Sedges
Most prevalent
• *Cyperus esculentus*
• *Cyperus rotundus*
Cynodon dactylon

Panicum dichotomiflorum
Weeds in Florida sugarcane

Most prevalent broadleaf weeds
- *Chenopodium album*
- *Amaranthus spinosus*

Others
- *Ambrosia artemisiifolia*
- *Portulaca oleracea*
- *Ipomea* spp.
- *Senna accidentalis*
- *Senna obtusifolia*
- *Solanum americanum*
- *Alternanthera philoxeroides*
Chenopodium album
Amaranthus spinosus
Florida broadleaf weed species are suitable food sources and oviposition sites for *Diaprepes abbreviatus*; however, sugarcane is generally more preferred for oviposition.

Weed management in Florida sugarcane

• Major cost associated with sugarcane production
• Weed control is most critical early in the season prior to sugarcane canopy closure over the row middles
• Weeds that mature and produce seed become
  – Sources of seed bank replenishment and re-infestation in subsequent years
Critical Timing of Fall Panicum (\textit{Panicum dichotomiflorum}) Removal in Sugarcane

Dennis C. Odero, Mathew Duchrow, and Nikol Havranek*

molibles, de caña, y de sucrose disminuyeron al aumentar la duración de la interferencia de \textit{P. dichotomiflorum}. La interferencia de \textit{P. dichotomiflorum} durante toda la temporada resultó en pérdidas de rendimiento de 34 a 60\%, 34 a 62\%, y 44 a 60\% de tallos molibles, caña, y sucrose, respectivamente. El momento crítico para la eliminación de \textit{P. dichotomiflorum} con base en AYL de 5 y 10\% de tallos molibles fue 5 y 9 semanas después de la emergencia (WAE) de la caña de azúcar. A 5 y 10\% de AYL, el momento crítico de eliminación de \textit{P. dichotomiflorum} varió desde 5 a 9 WAE y 6 a 8 WAE para la pérdida de rendimiento de caña y sucrose, respectivamente. Estos resultados muestran que \textit{P. dichotomiflorum} compite con la caña de azúcar, temprano durante la temporada de crecimiento, lo que demuestra la necesidad de controlar esta maleza a tiempo, temprano en la temporada, para reducir sus efectos negativos sobre el rendimiento.
Weed management in Florida sugarcane

- Weed management in Florida sugarcane uses a combination of different methods
  - Prevention
  - Eradication
  - Control
Weed management: prevention

• Keeping weeds out of sugarcane fields
• Accomplished by
  – Field sanitation
  – Control of volunteer weeds
  – Planting clean seed cane or certified rotational crop seed
  – Cleaning field equipment
  – Scouting for new infestations, spot treatments
• When properly employed, greatly reduces weed problems
Weed management: eradication

• Complete elimination of all living plants including their vegetative propagules and seeds
• Justified only for the elimination of perennial weeds in limited areas in sugarcane fields using mainly glyphosate
  – Sorghum almum
  – Pennisetum purpureum
  – Panicum repens
Weed management: control

- Process of limiting weed infestations and minimizing weed competition in sugarcane fields
  - **Goal**: have minimal effect of weeds on sugarcane growth and yield
- Degree of control is a matter of **economics**, the balance between **cost of control** and **sugarcane yield loss**
- Methods of weed control
  - Mechanical/physical
  - Cultural
  - Chemical
Weed control: mechanical

- **Cultivation** conducted before planting during field preparation to
  - Control emerged weed seedlings
  - Destroy residues from the previous crop
  - Aid in soil aeration and water infiltration
- Important especially when preemergence herbicide use is limited due to dry conditions associated with sugarcane planting and harvesting in Florida
Weed control: mechanical

- Cultivation when weeds are not present is not recommended because it can
  - Encourage germination of additional weed seeds
  - Remove the layer of herbicide present when soil-applied herbicides are used
- In ratoon crops, mechanical cultivators must
  - Cut through surface debris and thoroughly mix the soil
  - Be between row middles and not over the row
Weed control: cultural

• Crop rotation
  – Allows for breaking of weed life cycles
  – Allows for rotation of herbicides and other weed control programs
    • Leafy green vegetables, sweet corn, snap bean, radishes, rice

• Bare fallow period has effectively been used to manage troublesome perennial grasses (*Cynodon dactylon*)
  – Using multiple cultivation & glyphosate application
Head lettuce
Snap beans
Head lettuce
Snap beans
Rice
Weed control: cultural

• Fertilizer placement
  – Placing the fertilizer where sugarcane and not weeds has access allows the cane to be more competitive
    • Banding reduces competitiveness and population density of weeds

• Selection of sugarcane cultivars that have quick canopy closure
Weed control: chemical

• Useful and economical tool in sugarcane production
• Must be incorporated into an overall management plan to obtain maximum benefit
• Application
  – Preemergence (PRE)
  – Postemergence (POST)
  – POST-directed
• Sprayer calibration is important before herbicide application
Weed control: herbicides

Preemergence
- Atrazine
- Metribuzin
- Pendimethalin
- S-metolachlor *

Postemergence
- 2,4-D amine
- Dicamba
- Ametryn
- Atrazine
- Metribuzin
- Mesotrione
- Topramezone *
- Asulam
- Halosulfuron
- Trifloxysulfuron

Preplant/Preemergence/Fallow
- Glyphosate
Preemergence herbicides: pendimethalin

Dissipation of oil-based pendimethalin

Dissipation of water-based pendimethalin

Odero & Shaner (2014) Weed Technol. 28:82-88
Preemergence herbicides: triazines

Dissipation of atrazine
$DT_{50}$ 4-10 days

Dissipation of metribuzin
$DT_{50}$ 19-24 days

Preemergence herbicides: S-metolachlor

Organic soil

Y = 3768.91 - 42.86*DAT  \( R^2 = 0.43 \)

Half life = 19 days

Y = 3792.58 - 27.57*DAT  \( R^2 = 0.26 \)

Half life = 62 days

Sandy soil

Y = 1548.01\exp^{-0.06(DAT)}

Half life = 12 days

Y = 1724.11\exp^{-0.03(DAT)}

Half life = 24 days

Fernandez et al. *In preparation*
Preemergence herbicides: Indaziflam
Preemergence herbicides: Indaziflam

$\text{Panicum dichotomiflorum}$
Postemergence herbicides

**Broadleaf weeds**
2,4-D, dicamba, atrazine, metribuzin, mesotrione, topramezone

**Grasses**
Asulam, trifloxysulfuron, ametryn*, metribuzin*

**Sedges**
Halosulfuron
Topramezone

- POST annual broadleaf and grass control in corn
- Inhibits carotenoid biosynthesis (HPPD-inhibitor Group 27)
- Efficacy increased with low rates of PS II inhibiting herbicides
Topramezone: 14 DAT

% Injury/Control

- Injury
- Fall panicum
- Spiny amaranth

- Top (1 fl oz)
- Top (2 fl oz)
- Top (2 fl oz) + Ame (1 fl oz) + Atr (0.5 gal)
- Top (1 fl oz) + Pen (0.75 gal) + Met (2 lb) + Top (1 fl oz)
- Top (1 fl oz) + Met (2 lb)
Topramezone: 42 DAT

% Control

- Fall panicum
- Spiny amaranth

- Top (1 fl oz)
- Top (2 fl oz)
- Top (2 fl oz) + Ame (1.5 lb)
- Top (1 fl oz) + Atr (0.5 gal) + Pen (0.75 gal) + Met (2 lb)
- Pen (0.75 gal) + Met (2 lb) + Top (1 fl oz) + Met (2 lb)

UF IFAS Extension UNIVERSITY of FLORIDA
Lumax

• A commercial premix of
  – Atrazine + Mesotrione + S-metolachlor

• PRE or early POST
  – Control of fall panicum & other weed species
Integrated Weed Management (IWM)

• Development of a weed management program using a combination of preventive, cultural, mechanical, and chemical practices

• Applying the principles of IWM
  – Minimize overall economic impact of weeds
  – Reduce environmental impacts of herbicides
  – Provide optimum economic returns

• Development of IWM program is based on a few general rules that can be used on any field
2. Help the crop compete against weeds

• Several things can be done to give the crop an advantage over weeds
  – Fertilizer placement
  – Competitive varieties
3. Keep weeds off balance

- Don’t give weeds a chance to adopt
  - Crop rotation
4. Making a control decision

• Scout your field to assess the type and number of weeds to help determine adequate spray operation and any other control measure
• Economic threshold – level of weed infestation at which the cost of weed control equals the increased return on the crop yield
• Consider the cost of delaying weed control
What constitutes an effective weed management program?

Identify the weed(s)

- Spiny amaranth
- Fall panicum
- American black nightshade
What constitutes an effective weed management program?

- Identify the weed(s)
- Select proper control measure(s)
- Use an integrated approach (use multiple tools)
- Implement the program
- Document and keep records
  - Field history
  - Cropping practices
Remember for chemical weed control

• Do it right
  – Proper herbicide(s)
  – Proper herbicide rate(s)
  – Proper placement of material
  – Proper time of application
  – Proper manner of application

• READ THE HERBICIDE LABEL