# Herbicides used for Turfgrass Management



#### **Pre-emergence Herbicides**

| C. Name   | T. Name          | Class    | Mode of action              | Uses   |
|-----------|------------------|----------|-----------------------------|--|
| Atrazine  | AAtrex<br>Nine-O | Triazine | Photosynthetic<br>Inhibitor | [C-4<br>grasses]<br>Annual<br>grasses<br>and broad<br>leaf weeds |
| Benefin   | Balan<br>2.5G    | DNA      | Root Inhibitor              | [C-3 & 4]<br>Annual<br>grasses                                   |
| Bensulide | Bensumec<br>4LF  |          | Inhibits root<br>growth     | [C-4<br>grasses]<br>Annual<br>grasses<br>and broad<br>leaf       |

| C. Name   | T. Name              | Class                   | Mode of action   | Uses   |
|-----------|----------------------|-------------------------|--|--|
| DCPA      | Dacthal<br>W75       | Phthalic<br>acid        | Disrupts mitosis   | [C-3 & 4]<br>Annual<br>broad leaf &<br>grasses                         |
| Dithiopyr | Dimensio<br>n<br>1EC | Substituted<br>pyridine | Disrupts mitosis   | [C-3 & 4]<br>Annual grass<br>& broad leaf<br>specially<br>crabgrass    |
| Endothall | Endothall<br>1.46WS  | Phthalic<br>acid        | Inhibits mRNA<br>activity,<br>decreases<br>respiration & lipid<br>metabolism | [C-3 & 4]<br>Annual &<br>perennial<br>broad leaf,<br>winter<br>annuals |

| C. Name      | T. Name                 | Class      | Mode of action  | Uses  |
|--------------|-------------------------|------------|---|---|
| Ethofumesate | Prograss                |            | Not known   | [C-3<br>grasses]<br>Annual<br>grasses &<br>broad leaf               |
| Isoxaben     | Gallery<br>1.5EC        |            | Inhibits<br>biosynthesis of<br>cellulose from<br>glucose. Disrupts<br>Root and<br>hypocotyle<br>development | [C-3 & 4<br>grasses]<br>Broad<br>spectrum<br>of broad<br>leaf weeds |
| Metolachlor  | Pennant<br>Liquid<br>8E | Acid amide | Inhibits lipid,<br>protein and<br>gibberellins<br>biosynthesis  | [C-4]<br>Yellow<br>nutsedge<br>control                              |

| C. Name       | T. Name                 | Class       | Mode of action                              | Uses  |
|---------------|-------------------------|-------------|---|---|
| Oxadiazon     | Chipco<br>Ronstar<br>2G | Oxydiazolin | Inhibits shoot<br>growth                    | [C-4<br>grasses]<br>Annual<br>grass<br>weeds              |
| Oryzalin      | Surflan<br>4AS          | DNA         | Inhibits mitosis<br>during cell<br>division | [C-4<br>grasses]<br>Annual<br>grasses &<br>broad leaf     |
| Pendimethalin | Lesco<br>Pre-M<br>3.3EC | DNA         | Inhibits mitosis<br>during cell<br>division | [C-3 & 4<br>grasses]<br>Annual<br>grasses &<br>broad leaf |

| C. Name    | T. Name                                  | Class               | Mode of action                              | Uses   |
|------------|--|---------------------|---|--|
| Prodiamine | Barricade<br>65WG<br>Topgun<br>Kusablock | DNA                 | Inhibits mitosis<br>during cell<br>division | [C-4 grasses]<br>Annual<br>grasses &<br>broad leaf                               |
| Pronamide  | Kerb 50W                                 | Acid amide          | Arrests cell<br>division                    | [C-4 grasses]<br>Annual<br>bluegrass<br>control                                  |
| Siduron    | Tupersan<br>50WP                         | Substituted<br>urea | Inhibits<br>photosynthesis                  | [C-3 grasses]<br>Annual<br>grasses.<br>Does not<br>interfere with<br>germination |



#### **Postemergence Herbicides**

| C. Name  | T. Name          | Class                                    | Mode of action             | Uses  |
|----------|------------------|--|----------------------------|---|
| Asulam   | Asulox<br>3.34WS | Sulfonyl<br>carbamate                    | Inhibits cell<br>division  | [C-4 grasses]<br>Annual grass<br>weeds                            |
| Bentazon | Basagran<br>4WS  |  | Inhibits<br>photosynthesis | [C-3 & 4<br>grasses]<br>Annual broad<br>leaf & yellow<br>nutsedge |
| Dicamba  | Banvel<br>4WS    | Growth<br>regulator<br>[benzoic<br>acid] | Regulates<br>growth        | [C-3 & 4<br>grasses]<br>Broad leaf<br>weeds                       |

| C. Name                             | T. Name        | Class                            | Mode of action                                      | Uses   |
|-------------------------------------|----------------|----------------------------------|---|--|
| Diclofop                            | Illoxan<br>3EC | Ayloxy<br>phenoxy<br>propionate  | Inhibits<br>biosynthesis of<br>lipids in<br>grasses | [Established<br>C-4 grasses]<br>Annual grass<br>weeds              |
| 2,4-D<br>2,4-DP<br>MCPA<br>Mecoprop | МСРР           | Growth<br>regulator<br>[Phenoxy] | Regulates<br>growth                                 | [C-3 & 4<br>grasses]<br>Broad leaf<br>weeds                        |
| DSMA                                | Drexel<br>3.6L | Methane<br>arsonate              | Contact<br>herbicide                                | [C-3 & 4<br>grasses]<br>Annual<br>grasses &<br>broad leaf<br>weeds |

| C. Name      | T. Name           | Class                            | Mode of action                                  | Uses  |
|--------------|-------------------|----------------------------------|---|---|
| Ethofumesate | Prograss<br>1.5EC |                                  |   | [C-4 grasses]<br>Annual grasses<br>& broad leaf,<br>yellow & purple<br>nutsedge |
| Fenoxaprop   | Acclaim<br>1EC    | Aryloxy<br>phenoxy<br>propionate | Biosynthesis<br>of lipids in<br>grasses         | [C-3 grasses]<br>Annual grasses<br>& bermudagrass                               |
| Glyphosate   | Roundup           |                                  | Inhibits<br>aromatic<br>amino acid<br>synthesis | Broad spectrum<br>Non selective   |

| C. Name    | T. Name        | Class                | Mode of action  | Uses   |
|------------|----------------|----------------------|---|--|
| Imazaquin  | Image<br>1.5LC | Imidazolinone        | Inhibits<br>branched chain<br>amino acid<br>synthesis | [C-4 grasses]<br>Broad leaf<br>weeds                             |
| MSMA       | Bueno 6        | Methane<br>arsonate  | Contact<br>herbicide                                  | [Established<br>C-4 grasses]<br>Grass &<br>broad leaf<br>weeds   |
| Sethoxydim | Vantage        | Cyclohexane<br>dione | Inhibits lipid<br>biosynthesis                        | [Centipede &<br>fine fescue]<br>Annual &<br>perennial<br>grasses |

| C. Name                   | T. Name               | Class               | Mode of action                | Uses  |
|---------------------------|-----------------------|---------------------|-------------------------------|---|
| Triclopyr +<br>Clopyralid | Confront              | Growth<br>regulator | Regulates<br>growth           | [C-3 & 4<br>grasses]<br>Annual &<br>perennial broad<br>leaf weeds |
| Clopyralid                | Lontrel               | Growth<br>regulator | Regulates<br>growth           | [C-3 & 4<br>grasses]<br>Annual &<br>perennial broad<br>leaf weeds |
| Diquat                    | Reward<br>Spectracide | Bipyridylium        | Cell<br>membrane<br>disruptor | Non selective   |

| C. Name  | T. Name                                      | Class | Mode of action                 | Uses  |
|--|--|-------|--------------------------------|---|
| Trifloxyslufuron<br>sodium<br>Sulfosulfuron<br>Formasulfuron<br>Nicosulfuron<br>Rimsulfuron<br>Metsulfuron<br>methyl<br>Primisulfuron<br>Flazasulfuron | Monument<br>Certainty<br>Revolver<br>Tranxit | SU    | ALC,<br>branched<br>amino acid | [C-4 grasses]<br>Selected grass<br>and broad leaf<br>control in warm<br>season grasses<br>Best for sedge<br>control |



#### **Sedge Control**



- Absorption
- Transloaction to storage organs like tubers, nutlets
- Effect germination of nutlets
- Viability of nutlets
- SU herbicides like Monument are most effective in controlling nutsedges



# **Trifloxysulfuron moving to CYPRO regrowth**



# Trifloxysulfuron uptake from soil application



1 DAT

2 DAT





Poa annua control with a single application of Monument 75 WG at 9.33 g/Acre.



### **PLANT RESPONSES**

- SUSCEPTIBLE
- TOLERANT
- **RESISTANT**



#### SUSCEPTIBLE OR TOLERANT

#### • SUSCEPTIBILITY

- Results in plants being killed or damaged by the applied herbicide
- TOLERANCE
  - Ability of a plant to withstand a predetermined dosage of a herbicide which may be overcome by higher dosages



#### RESISTANCE

 Ability of a biotype to survive a treatment with a given herbicide to which the weed species is normally susceptible



## HERBICIDE RESISTANCE

- CROSS RESISTANCE
  - Refers to a biotype that is resistant to two or more chemically similar herbicides
  - SAME MODE OF ACTION
  - Example
    - *Chenopodium album* resistant to atrazine and simazine



## HERBICIDE RESISTANCE

- MULTIPLE RESISTANCE
  - Refers to weed biotype that is resistant to two or more chemically unrelated herbicides
  - DIFFERENT MODES OF ACTION
  - Example
    - *Kochia scoparia* resistant to triazine and ALS inhibitor



## **Resistance Management Strategy**

- Identify the weed
- Check the label rate of the herbicide used
- If tolerance or resistance is detected rotate to a different class of herbicide with a different mode of action
- Some herbicides may belong to different chemical classes but they may have the same mode of action
  - Eg. Imazaquin and trifloxysulfuron sodium both have the same mode of action but belong to 2 different chemical classes