### Most Troublesome Weeds in Corn vs Turf in NC*

<table>
<thead>
<tr>
<th>Corn</th>
<th>Turf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morningglories</td>
<td>Annual Bluegrass</td>
</tr>
<tr>
<td>Burcucumber</td>
<td>Dallisgrass</td>
</tr>
<tr>
<td>C. Milkweed</td>
<td>Kyllinga spp.</td>
</tr>
<tr>
<td>H. Dogbane</td>
<td>Crabgrasses</td>
</tr>
<tr>
<td>C. Horsenettle</td>
<td>Goosegrass</td>
</tr>
<tr>
<td>C. Bermudagrass</td>
<td>V. Butianweed</td>
</tr>
<tr>
<td>B. Signalgrass</td>
<td>Purple Nutsedge</td>
</tr>
<tr>
<td>Texas Panicum</td>
<td>Violets</td>
</tr>
<tr>
<td>Purple Nutsedge</td>
<td>Yellow Nutsedge</td>
</tr>
<tr>
<td>Fall Panicum</td>
<td>Wild Garlic</td>
</tr>
</tbody>
</table>

* Ten most troublesome weeds in southern regions, SWSS, 2000

### What is a Weed?

- A plant growing where it is not wanted
The Nature of Weeds

- Opportunistic plants
- Adapted to “niches” within the environment.
- Herbicides can eliminate the weed, but not the environmental conditions that provided an “opportunity” for that weed.

A paradigm shift
From weed control to weed management

Weed Management

- Herbicides are effective means of control.
- However . . .
  - Elimination of the weed does not eliminate the environmental condition that creates a competitive advantage.
  - How heterogeneous are turfgrass environments?
  - Current management practices assume homogeneity.

Weeds vs. Turf

Plant Competition:
- Light – most plants compete for this
- Nutrients
- H₂O
- CO₂

Smooth Crabgrass Control in Tall Fescue

Evaluations collected 09-16-04, 196 DAIT. Treatments applied: Mar 04 and April 26

Evaluations collected 09-06-05, 186 DAIT. Treatments applied: Mar 04 and April 28
Why Do We Have Weed Problems?

1. Turfgrasses are non-native plants
2. Monocultures
3. Lack of sanitation
4. Cosmetic standards

Why Do We Have Weed Problems?

• Turfgrasses are not native (depending on where you are of course):

✓ Growing non-native vegetation is always difficult

Why Do We Have Weed Problems?

• Ecology 101:

✓ Natural Succession: Long term transition of vegetation types to a condition of stability.

Why Do We Have Weed Problems?

• Monocultures – growth of a single species

✓ Monocultures tend to be man-made. In turf, we force mother nature’s hand to compete against us.
Why Do We Have Weed Problems?

- Lack of Sanitation and Natural Movement

- People (shoes) and equipment (mowers, sprayers, tillage implements) movement from site to site spread weed seeds, tubers, bulbs, rhizomes, stolons, etc. Animals, wind and rain also spread weeds.

Perennial Ryegrass (*Lolium perenne*)

Tubers
Thickened portions of rhizomes or roots, serving for food storage and also for propagation (yellow nutsedge example)

Rhizomes
Underground stems that can emit roots from the lower side and leafy stems from the upper side (green kyllinga ex.)

Wild Garlic

Bulbs
Short, vertical, underground organs for food storage or reproduction on which specialized leaves prominently develop

Why Do We Have Weed Problems?

- Stolons: Aboveground stems that grow horizontally and root at the nodes to develop new plants
Yellow Nutsedge (Cyperus esculentus)

Purple Nutsedge (Cyperus rotundus)

Sandbur (Cenchrus spp.)
Turf Species

- Warm-Season:
  - Bermudagrass
  - Zoysiagrass
  - Centipedegrass
  - St. Augustinegrass

- Cool-Season:
  - Tall Fescue
  - Kentucky Bluegrass
  - Perennial Ryegrass
  - Tall Fescue/Bluegrass/Fine Fescue
  - Tall Fescue/KY Bluegrass
  - Bentgrass

Weed Species That are Increasing in Turf Areas

- Sedge ssp.
  - Green Kyllinga (*Kyllinga brevifolia*)
  - False Green Kyllinga (*Kyllinga gracillima*)
  - Yellow Nutsedge (*Cyperus esculentus*)
  - Purple Nutsedge (*Cyperus rotundus*)
  - Annual Sedge (*Cyperus compressus*)

Weed Species That are Increasing in Turf Areas (cont.)

- Paspalum ssp.
  - Dallisgrass (*Paspalum dilatatum*)
  - Field paspalum (*Paspalum laeve*)
  - Thin paspalum (*Paspalum setaceum*)
  - Bahiagrass (*Paspalum notatum*)

- Perennial Ryegrass (*Lolium perenne*)
Dallisgrass (*Paspalum dilatatum*)

**Difficult to Control Weeds**

- Dallisgrass (*Paspalum dilatatum*): found anywhere
- Field paspalum (*Paspalum laeve*): moist areas
- Thin paspalum (*Paspalum setaceum*): sandy areas
- Perennials. All resemble one another. Often mistaken for dallisgrass.

**Control.** MSMA applied at full rate 7 – 10 days apart. Begin treatment when grasses are in 2 – 4 leaf stage.

Wild Garlic (*Allium vineale*)

Bahiagrass (*Paspalum notatum*)
Perennial Ryegrass (*Lolium perenne*)

Use a PRE just before overseeding

Smutgrass (*Sporobolus indicus*)

Goosegrass (*Eleusine indica*)

Virginia Buttonweed (*Diodia virginiana*)

Spurweed (*Soliva pterosperma*)
Purple Nutsedge Biology and Ecology

- Has tubers, rhizomes, and bulbs. Tubers produced in chains along rhizomes.
- One of the most prolific and difficult to control weeds in turfgrasses
- Survives and spreads at 0.5 inch mowing ht.
- Generally considered the world's worst weed.

Purple Nutsedge (Cyperus rotundus)

- One purple nutsedge tuber can produce 99 tubers in 90 days (Rao, 1968)
- Purple nutsedge can spread as much as 35 inches and produce 1000 new tubers/yd in 2 months (Horwitz, 1972)
- In 18 weeks, 3 purple nutsedge tubers produce 1,665 new tubers and 639 feet of rhizomes (Summerlin and Yelverton, 1997)
Green Kyllinga (Kyllinga brevifolia) & False Green Kyllinga (K. gracillima)

- A rhizomatous perennial. Round or oblong, simple seedhead. Three short leaves just below seedhead. Reach a height of 6 in
- Able to thrive under close mowing of ½”
- Reproduces by seed and rhizomes
- Rhizome internode length is < ½”; thus, producing a high shoot density and “mat-like” growth habit

Effects of Mowing

Why Do Weeds Occur Where They Do

- Every turfgrass species has an ideal mowing height for a particular environment.

Effect of Mowing Height on Large Crabgrass Incidence

- 3.5lbs Crabgrass/1000ft² on March 7, 2007
- Mowing Heights initiated when soil temperatures reached 55°F – Mowed every 4 days thereafter

Effect of Mowing Height on Large Crabgrass Incidence

- Bermudagrass mowing heights – 0.5”, 1”, 1.5”, 2.0”
- Tall fescue mowing heights – 1”, 2”, 3”, 4”
Effect of Tall Fescue Mowing Height on Crabgrass Incidence

Data Collected: 09-13-07, LSD (P=0.05), Sandhills Research Station, Sodman 90/10 (mixture w/ bluegrass)

Effect of Bermudagrass Mowing Height on Incidence of Crabgrass

Data Collected: 09-13-07, LSD (P=0.05), Lake Wheeler Field Labs

Effect of Mowing on Purple Nutsedge (*Cyperus rotundus*) 18 WAP, Jackson Springs, NC

Summerlin et al, 2000 Weed Sci. 48:501-507
Effect of Mowing on Green Kyllinga (K. brevifolia) 18
WAP, Jackson Springs, NC

<table>
<thead>
<tr>
<th>Mowing Ht (in.)</th>
<th>Biomass (g/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/8&quot;</td>
<td>0.98</td>
</tr>
<tr>
<td>5/32&quot;</td>
<td>1.01</td>
</tr>
<tr>
<td>3/16&quot;</td>
<td>0.76</td>
</tr>
</tbody>
</table>

LSD (0.05) = 0.09

Summerlin et al., 2000
Weed Sci. 48:501-507

Tall fescue

Mowing Ht effects on ‘Penncross’ Root Biomass

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Correlation</th>
<th>Range</th>
<th>Def/Tox</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevation</td>
<td>-0.58**</td>
<td>0.63 m</td>
<td>-----</td>
</tr>
<tr>
<td>H₂O</td>
<td>0.40**</td>
<td>41 - 59 % vol.</td>
<td>-----</td>
</tr>
<tr>
<td>pH</td>
<td>0.56**</td>
<td>5.9 - 6.9</td>
<td>-----</td>
</tr>
<tr>
<td>P</td>
<td>-0.11</td>
<td>77-195 ppm</td>
<td>&lt;50</td>
</tr>
<tr>
<td>K</td>
<td>0.53**</td>
<td>0.2 - 0.5 meq</td>
<td>&lt;0.25</td>
</tr>
<tr>
<td>Na</td>
<td>0.67**</td>
<td>1.5-8% of CEC</td>
<td>&gt;20%</td>
</tr>
</tbody>
</table>

* P<0.05.
** P<0.001.

Fagerness & Yelverton, 2001
Crop Sci. 41:1901-1905

Fairfield Harbour: Green kyllinga correlations
Elevation map of Bentwinds CC fairway with density of *K. gracillima* expressed with increasing green color intensity. Red outline denotes survey area.

Fairfield Harbour

Annual Sedge (*Cyperus*

Bermudagrass (*Cynodon dactylon*)

Wild Violet (*Viola* spp.)

Field Pansy (*Viola* spp.)
Why Do We Have Weed Problems?

- **Cosmetic Standards** – in turf, we place a high value on appearance.
Highly Tall fescue Annual bluegrass has strong light requirement for seed
Must
Sedges,

Weeds as Indicators
- Low soil pH
- High soil pH
- Droughty soils
- Wet soils (overwatering)
- Poor(sandy) soils
- Red Sorrel
- Plantains
- Prostrate Spurge, Black Medic, Knotweed, Woodsorrel, Lespedeza, Bracted Plantain
- Sedges, Poa annua, Alligatorweed, Moss, Algae, Goosegrass
- Quackgrass, Poorjoe, sandspur

Weeds as Indicators (cont.)
- High Nematodes
- Low Mowing Ht.
- Compacted Soil
- Low Soil N
- High Soil N
- Spurges, Pusley, Knotweed
- Algae, Poa annua, Moss, Chickweed
- Goosegrass, Poa annua, Knotweed
- Legumes (Clover, lespedeza, vetch, Black Medic), Broomsedge, Yellow Sneezeweed
- Poa annua, Moss, Chickweed, Ryegrass

Be careful
Inspect sod
Weed Management in Turfgrass:

- Select adapted grass species
- Mow at proper height and frequency
- Fertilize at proper time and rate

Weed Species That are Increasing in Turf Areas (cont.)

Japanese Stiltgrass (M. vimineum)

Flowering

Soil Temps For Weed Germination

<table>
<thead>
<tr>
<th>Weed Species</th>
<th>Critical Soil Temp (° F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crabgrass (Large and Smooth)</td>
<td>55</td>
</tr>
<tr>
<td>Goosegrass</td>
<td>60</td>
</tr>
<tr>
<td>Barnyardgrass</td>
<td>60</td>
</tr>
<tr>
<td>Foxtails (Yellow or Green)</td>
<td>65</td>
</tr>
</tbody>
</table>

From Managing Turfgrass Pests, Watschke et al.
Crabgrass Germination:

- Watch for areas that warm up more quickly:
  - south-facing slopes
  - sandy soils

Weed Control With Preemergence Herbicides

Herbicides do not prevent weeds from germinating; they kill weeds as they grow through the herbicide treated zone.

Large gaps in herbicide barriers result in weed escapes.

PRE Smooth Crabgrass Control With Barricade

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Lbs AI/A</th>
<th>% Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nontreated</td>
<td>--</td>
<td>0</td>
</tr>
<tr>
<td>Barricade 65 WG</td>
<td>0.75</td>
<td>98</td>
</tr>
<tr>
<td>Barricade 0.5 G</td>
<td>0.75</td>
<td>81</td>
</tr>
<tr>
<td>Barricade 0.29 G</td>
<td>0.75</td>
<td>91</td>
</tr>
<tr>
<td>LSD 0.05</td>
<td></td>
<td>9.3</td>
</tr>
</tbody>
</table>

Experimental Barricade Formulations
Hidden Valley GC, 1996. Applied March 4, evaluated Sept. 26

Preemergence Control of Weeds with

- Split Application:
  - Split rate in half. Apply first application at normal time and second application 8 weeks later. This usually extends control later into the season.
Single Vs. Split Applications, 1995
Hidden Valley GC

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<td>--</td>
<td>0</td>
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<tr>
<td>Barricade</td>
<td>0.75</td>
<td>85</td>
</tr>
<tr>
<td>Barricade/Barricade</td>
<td>0.5/0.25</td>
<td>97</td>
</tr>
</tbody>
</table>

Final Rating, 9-15-95
Applications Made 3-23-95 & 5-19-95

Single Vs. Split Applications, 1995
Thorndale CC, Oxford, NC

<table>
<thead>
<tr>
<th>Treatment</th>
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<tbody>
<tr>
<td>Nontreated</td>
<td>--</td>
<td>0</td>
</tr>
<tr>
<td>Pendimethalin</td>
<td>3</td>
<td>97</td>
</tr>
<tr>
<td>Pendimethalin/Pendimethalin</td>
<td>1.5/1.5</td>
<td>95</td>
</tr>
</tbody>
</table>

Final Rating, 9-13-95
Applications Made 3-26-95 & 5-11-95

Major Preemergence Crabgrass/

- Dinitroanalines - DNAs:
  - prodiamine (Barricade)
  - oryzalin (Surflan)
  - pendimethalin (Pendulum, Pre-M, etc.)
  - Team Pro (trifluralin + benefin)
  - XL (oryzalin + benefin)

- Oxadiazole
  - oxadiazon (Ronstar)

- Pyridines
  - dithiopyr (Dimension)

Dinitroanalines and Dimension

- Behavior in Plants: Absorbed by roots and emerging shoots and inhibit mitosis which prevents cell division and elongation. Sensitive species fail to emerge.
Turfgrasses may have Oxadiazon (Ronstar)

- **Behavior in Plants:** Absorbed by *emerging shoots* of sensitive species and effects and enzyme of chlorophyll which results in a loss of chlorophyll and carotenoids and young seedling dies.

Ronstar does

**Particles Have A Sphere of Influence**

**Size of Particle is Critical**
Uniformity of Particle Size

Coverage with Granular vs Spray

PRE Smooth Crabgrass Control With Barricade

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<td>9.3</td>
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</table>

Experimental Barricade Formulations
Hidden Valley GC, 1996. Applied March 4, evaluated Sept. 26

Crabgrass Control with Dimension Impregnated on Fertilizer

<table>
<thead>
<tr>
<th># particles/g</th>
<th>0.25 lbs ai/a</th>
<th>0.5 lbs ai/a</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>27</td>
<td>66</td>
</tr>
<tr>
<td>58</td>
<td>48</td>
<td>75</td>
</tr>
<tr>
<td>165</td>
<td>56</td>
<td>75</td>
</tr>
<tr>
<td>465</td>
<td>59</td>
<td>84</td>
</tr>
<tr>
<td>1310</td>
<td>68</td>
<td>82</td>
</tr>
</tbody>
</table>

Kelly and Coats, MSU (unpublished data)

PRE Smooth Crabgrass Control with Dimension*

<table>
<thead>
<tr>
<th>Treatment</th>
<th>lbs ai/a</th>
<th>% Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nontreated</td>
<td>--</td>
<td>0</td>
</tr>
<tr>
<td>Dimension 1EC</td>
<td>0.5</td>
<td>90</td>
</tr>
<tr>
<td>Dimension 0.25C</td>
<td>0.38</td>
<td>98</td>
</tr>
<tr>
<td>LSD 0.05</td>
<td></td>
<td>NS</td>
</tr>
</tbody>
</table>

*Experimental Dimension Formulations
Thorndale GC, 1995. Applied March 16, evaluated Sept. 19

Fertilizer + Herbicide Particle Size

- When using lower than normal rates, control decreased as particle size increased.
Spring Preemergence Herbicide Applications

- Certain labels caution against it.
- Safety depends on root growth and establishment.

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Oct. 2</th>
<th>Oct. 16</th>
<th>Oct. 30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barricade 0.75 lb/a</td>
<td>46</td>
<td>49</td>
<td>64</td>
</tr>
<tr>
<td>Dimension 0.5 lb/a</td>
<td>23</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>Team 3 lb/a</td>
<td>17.5</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>pendimethalin 3 lb/a</td>
<td>35.0</td>
<td>24</td>
<td>33.0</td>
</tr>
</tbody>
</table>

Herbicides applied March 11; ratings 4-18

PRE Control of Crabgrass

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Oct. 2</th>
<th>Oct. 16</th>
<th>Oct. 30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pendimeth DG 3 lb ai</td>
<td>50</td>
<td>96</td>
<td>90</td>
</tr>
<tr>
<td>Pendimeth G 3 lb ai</td>
<td>90</td>
<td>86</td>
<td>85</td>
</tr>
<tr>
<td>Barricade WG .75 lb ai</td>
<td>75.00</td>
<td>76</td>
<td>86</td>
</tr>
<tr>
<td>Ronstar WP 3 lb ai</td>
<td>86</td>
<td>91</td>
<td>91</td>
</tr>
<tr>
<td>Ronstar G 3 lb ai</td>
<td>91</td>
<td>54</td>
<td>54</td>
</tr>
</tbody>
</table>

Ratings taken Sept 19. Rates are per acre applied 3-1. Thorndale CC, 2002
PRE Control of Crabgrass

Ratings taken Sept 19. Rates are per acre applied 3-1.
Thorndale CC, 2002