Herbicide Resistance

To understand the concept of herbicide resistance and how to avoid or manage resistant weed populations, it will be helpful to understand the following terms.

- Tolerance
- Susceptibility
- Mode of Action
- Resistance
Herbicide Resistance

Tolerance

The ability of a turfgrass or weed species to withstand the effects of an applied herbicide naturally.

For example, most turfgrasses are tolerant of broadleaf herbicides. Dandelions are tolerant of crabgrass herbicides (Barricade, Pre-M, etc…).
Herbicide Resistance

Susceptibility

The inability of either desirable species or weeds to withstand the effects of an applied herbicide.

For example, common chickweed is killed by Confront consistently, meaning it is susceptible to Confront. A tall fescue lawn is tolerant of Confront and is susceptible to Roundup.
Herbicide Resistance

Mode of Action

Mode of Action is a herbicide’s sequence of events, including absorption, movement in the plant (translocation) to the target site, and activity at the target site (e.g. simazine, atrazine blocks photosynthesis) which, together, result in the herbicide killing susceptible plants.
Herbicide Resistance

Resistance

The ability of some weeds in an existing population to withstand the effects of an applied herbicide when the population is normally susceptible.
Herbicide resistant weeds should be a concern to anyone that applies herbicides on a regular basis. This is true even where successful herbicide programs exist.

Why is this???
Herbicide Resistance

Example:
We have learned that DNA herbicides provide excellent crabgrass and very good goosegrass control in many turf situations (home lawns, golf courses, nonresidential turf, etc...).

Doesn’t it make sense to use a DNA herbicide every single year since they are so effective?
Herbicide Resistance

The problem with using any herbicide family without change is that weed populations are not identical.

Resistance does not appear and become a problem because of genetic mutations or changes in plants.

Resistant plants already exist within the population.
Herbicide Resistance

Resistant plants become a problem when the susceptible members of the population are killed by herbicide applications.

The resistant plants escape, reproduce, and over time, can become the majority of the population. The susceptible plants eventually are replaced by the resistant plants.
Herbicide Resistance

Resistance is encouraged when the same herbicide or herbicide family is used year after year for the same weed control.

Two examples of herbicide resistant weeds:

Goosegrass has been documented as becoming resistant to DNA herbicides.

Annual bluegrass has been documented as becoming resistant to triazine herbicides.
Herbicide Resistance

If goosegrass becomes resistant to Barricade (DNA herbicide), there’s a good chance that it will be resistant to Pre-M, Balan, Surflan, etc… (other DNA herbicides) because they all kill weeds with the same mode of action. Remember, DNA herbicides are root inhibitors that affect cell division. They basically kill susceptible weeds the same way.
Herbicide Resistance

The same goes for annual bluegrass. If annual bluegrass becomes resistant to atrazine, it probably will have resistance to simazine or metribuzin. These herbicides are all photosynthetic inhibitors and kill susceptible annual bluegrass plants the same way.
Herbicide Resistance

The way to avoid or delay herbicide resistance is to rotate not just herbicides from year to year, but also **herbicide families**!

To best avoid the proliferation of resistant weeds, a different herbicide family should be used at least one year out of every four.
Herbicide Resistance

Why would rotating herbicide families be a potential problem for turfgrass managers???
Herbicide Resistance

Why would rotating herbicide families be a potential problem for turfgrass managers???

Several Reasons

Turfgrasses are generally considered perennial plantings. They remain the same year after year. Depending on the turfgrass species, you may not have many effective available options to begin with. Some of your alternative options may not provide acceptable control.
Herbicide Resistance

Why would rotating herbicide families be a potential problem for turfgrass managers???

Several Reasons

Many turfgrass managers overseed. This common practice limits even further the number of available effective herbicides or herbicide families that can be applied safely.
Herbicide Resistance

What can turf managers do to battle resistance?
Herbicide Resistance

What can turf managers do to battle resistance?

You as a turf manager may decide to skip an overseeding for one year so that an alternative herbicide family can be utilized.
Plant Growth Regulators (PGRs)

The use of PGRs is not with the intent to kill plants but rather to stunt or alter growth.

The target plants for PGRs are usually desirable turfgrass species instead of the weeds which may invade them.
Plant Growth Regulators (PGRs)

Three reasons PGRs are used in turfgrass:

1. Reduce turfgrass growth
2. Enhance turfgrass quality
3. Shift competition from *poa annua* to bentgrass
Plant Growth Regulators (PGRs)

PGRs... are used widely to suppress seedhead / vegetative growth in utility turfgrass.

...are used widely in golf courses to reduce mowing frequency and enhance turf quality.
Plant Growth Regulators (PGRs)

PGRs are classified into two groups – Type I and Type II.

**Type I PGRs** inhibit cell division (mitosis) of turf leaves and stems can be foliar absorbed, or root and foliar absorbed slow or stop top growth and suppress seedheads can cause discoloration because of stopped growth work quickly (4 - 10 days) and last 3 – 4 weeks
Plant Growth Regulators (PGRs)

Type I PGRs are generally used for seedhead suppression to reduce mowing in low maintenance areas that are difficult to mow, such as ditches, roadsides, and steeped embankments.

One exception to this is mefluidide use for annual bluegrass seedhead suppression in late winter through early spring, especially in ryegrass overseeded bermudagrass.
Plant Growth Regulators (PGRs)

Type I PGRs

The following PGRs are growth suppressors and inhibitors, and are foliar or root absorbed.

Maleic hydrazine (Royal Slo-Gro)
Mefluidide (Embark, Embark Lite)
Plant Growth Regulators (PGRs)

Type I PGRs

The following PGRs are herbicide growth regulators (herbicides used at sublethal rates) and are foliar absorbed only.

Glyphosate (Roundup Pro, Roundup ProDry)

Chlorsulfuron (Telar)

Sulfometuron (Oust)

Metsulfuron (Escort)

Imazapic (Plateau)
Plant Growth Regulators (PGRs)

PGRs are classified into two groups – Type I and Type II.

**Type II PGRs**

inhibit cell elongation by interfering with gibberellic acid (GA) biosynthesis within plants. GA is a plant hormone responsible for cell elongation.

can be root and foliar absorbed

Are true PGRs
Plant Growth Regulators (PGRs)

What are the results of GA synthesis inhibition?

1. Darker green tissue
2. Slower growing tissue
3. Increased chlorophyll content
4. More compact leaf canopy
5. Reduced need for mowing
Plant Growth Regulators (PGRs)

Type II PGRs generally have less impact on turfgrass quality and are therefore more commonly used in high maintenance turf such as golf courses. Common uses include…

1. Reducing growth in high maintenance turf
2. Enhancing quality and density of high maintenance turf
3. Suppression of annual bluegrass
Plant Growth Regulators (PGRs)

**Type II PGRs**

Paclobutrazol (Trimmit, TGR Turf Enhancer)
Flurprimidol (Cutless)
Trinexapac-ethyl (Primo)
Ethephon (Proxy)
Plant Growth Regulators (PGRs)

Most Type II PGRs are effective for four to six weeks per application. For consistent growth regulation of cool season turfgrasses...

Apply twice in the fall (four to five week intervals)
Apply twice in the spring (same as above)
Plant Growth Regulators (PGRs)

Most Type II PGRs are effective for four to six weeks per application. For consistent growth regulation of warm season turfgrasses...

Apply three times during the summer at four to five week intervals.
Plant Growth Regulators (PGRs)

Research has shown that inconsistent or single applications of Type II PGRs may result in a “rebound effect”, where growth is suppressed for four to six weeks but in the absence of followup applications, growth may surge above normal levels.

This effect can cause problems in warm season turfgrasses that are prone to scalping.
Plant Growth Regulators (PGRs)

Define tolerance, susceptibility, resistance, mode of action
Why are resistance problems occurring where successful herbicide programs exist
List 2 examples of herbicide resistance in turf situations
How can you combat, delay, hopefully prevent herbicide resistance
What is purpose of PGRs, why are they used in turf
Do Type I and Type II PGRs work quick, slow
Name a Type I and Type II PGR
Plant Growth Regulators (PGRs) Review - continued

What type PGRs are true PGRs and have no herbicidal effects

Type II PGRs interfere with gibberellic acid (GA) biosynthesis – what does this mean to the turf plant

What type PGR is used in low maintenance / high maintenance turf