What is a Plant Growth Regulator?

An organic compound, natural or synthetic, when present (or applied) in small amounts results in a change in plant growth and development.

Change = Better Color, Increased Density, Fewer Clippings, No Seedheads, Enhanced Establishment, Improved Recuperative Potential, Deeper Roots, Larger Food Reserves, etc.
Natural Plant Growth Regulators

- Abscisic acid: closes stomata, inhibits germination, gibberellic acid & cytokinins

- Auxins: Apical dominance, cell enlargement, root growth, inhibit axillary buds

- Cytokinins: Cell division and enlargement, flowering senescence, inhibit auxins
Natural Plant Growth Regulators

- **Ethylene**: Stress stimulated, root growth

- **Gibberellins**: Cell elongation, photoperiod response, chilling tolerance

- **Polyamines**: Increase growth and cell division, slow chlorophyll degradation
Synthetic PGRs Developed for Turf

Type I Classification:
Growth Suppressors and Inhibitors

Either foliar or root absorbed

- Amidochlor (Limit)
- EPTC (Shortstop)
- Maleic hydrazide (Royal Slo-Gro)
- Mefluidide (Embark)
Synthetic PGRs Developed for Turf

Type I Classification:
Herbicide Growth Regulators

Foliar absorbed

Chlorsulfuron (Telar DF)
Glyphosate (Roundup Pro, Touchdown Pro)
Imazapic (Plateau)
Imazethapyr + Imazapyr (Event)
Metsulfuron methyl (Escort)
Sulfometuron methyl (Oust)
Synthetic PGRs Developed for Turf

Type II Classification:
True Plant Growth Regulators

Root or foliar absorbed

- Ethephon (Proxy)
- Flurprimidol (Cutless 50W)
- Paclobutrazol (Trimmit 2SC, TGR Turf Enhancer 2SC)
- Trinexapac-ethyl (Primo Maxx)
Turfgrass Plant Growth Regulators

- Alter plant growth:
  - Seedhead suppression
  - Vegetative growth suppression

- Mode of action:
  - Inhibit cell division and/or elongation
  - Inhibit gibberellin biosynthesis
  - Sublethal rates of herbicides
PGRs for High Maintenance Areas

Golf Courses – Type II PGRs

Bermudagrass and bentgrass greens

- Slow or control growth
- Increase ball roll (possibly)
- Improve color (possibly)
- Enhance quality (possibly)
- Reduce or shift *poa annua* competition
PGRs for High Maintenance Areas

Golf Courses – Type II PGRs

Fairways

- Reduce mowing frequency
- Enhance turfgrass quality (possibly)
PGRs for High Maintenance Areas

Certain Home Lawns and Commercial Properties – Type II PGRs

- Reduce mowing frequency
- Enhance turfgrass quality and density (possibly)
PGRs for High Maintenance Areas

Type II PGRs: inhibit cell elongation by interfering with gibberellic acid (GA) biosynthesis

- Darker green, slower growing tissue
- Increased chlorophyll content
- More compact leaf canopy due to shortened internodes
PGRs for High Maintenance Areas

Type II PGRs

- Very little to no phytotoxicity
- Minimal impact on turfgrass quality
- Usually ineffective for seedhead suppression
- Effective for 4 to 6 weeks per application
Cool Season Turfgrass Growth Habit and PGR Timing for North Carolina

Fall: apply up to 2x (stop 1 mo. before frost)

Spring: apply up to 2x (begin at new growth)
Warm Season Turf Growth Habit and PGR Timing for North Carolina

3 applications starting in late spring before seedhead formation at 4 to 5 week intervals
Primo Maxx

- Class A, Type II PGR
- Typical use rate: 12 to 16 oz / acre / appl.
- Bermudagrass and bentgrass greens, fairways, home lawns, commercial property
- Not effective for *poa annua* reduction
Effects of Primo on ‘Tifway’ Bermudagrass Foliar Growth (Multiple App.)

Nontreated vs. Primo 12 oz/a + 4 & 8 wk vs. Primo 8 oz/a + 4 & 8 wk

% Change in Clipping Weight

Wk After Initial Treatment

Fagerness & Yelverton
Crop Science 40:493-497
Effects of Primo on ‘Tifway’ Bermudagrass Quality (Multiple App.)

![Graph showing the effects of Primo on turf quality over 12 weeks.](image)

- Nontreated
- Primo 12 oz/a + 4 & 8 wk
- Primo 8 oz/a + 4 & 8 wk

Fagerness & Yelverton
Crop Science 40:493-497
Trimmit 2SC / TGR Turf Enhancer 2SC

- Class B, Type II PGR
- Use rate: 1.5 pt / acre / application
- May cause undesirable growth retardation and phytotoxicity on bermudagrass, especially ultra-dwarf cultivars
Effects of Primo and Trimmit 2SC on ‘Tifway’ Bermudagrass Foliar Growth

Effects of Primo and Trimmit 2SC on ‘Tifway’ Bermudagrass Foliar Growth

% Change in Clipping Weight

Wk After Initial Treatment

NCSU Turf Field Lab, 2000
Effects of Primo and Trimmit 2SC on ‘Tifway’ Bermudagrass Quality

![Graph showing turf quality over weeks after initial treatment with different treatments.]

- Nontreated
- Primo 12 oz/a + 4 wk
- Primo 16 oz/a + 4 wk
- Trimmit 1.5 pt/a + 4 wk
- Trimmit 2 pt/a + 4 wk

NCSU Turf Field Lab, 2000
Effects of PGRs on Common Bermudagrass Foliar Growth

% Change in Clipping Weight

-100 -80 -60 -40 -20 0 20 40 60

Wk After Initial Treatment

Nontreated
Primo 12 oz/a + 4 wk
Proxy 5 oz/M + 4 wk
Trimmit 2 pt/a + 4 wk

NCSU Turf Field Lab, 1999
Effects of PGRs on Common Bermudagrass Quality

Wk After Initial Treatment

Turf Quality (1-9)

- Nontreated
- Primo 12 oz/a + 4 wk
- Proxy 5 oz/M + 4 wk
- Trimmit 2 pt/a + 4 wk

NCSU Turf Field Lab, 1999
Effects of PGRs on ‘Tifway’ Bermudagrass Foliar Growth

NCSU Turf Field Lab, 1999
Effects of PGRs on ‘Tifway’ Bermudagrass Quality

NCSU Turf Field Lab, 1999
**Poa annua** Management in Bentgrass Greens

- Apply at 4 week intervals
- Begin late summer / early fall
- Postpone treatments in winter
- Continue late winter / early spring

Several years needed for bentgrass to **slowly** outcompete *poa annua*
Poa annua ssp. annua Control in Bentgrass Greens

All rates are lb ai/a
Applications: 10-15, 11-12, 03-12, 04-13
Quail Ridge, 1998-99
**Poa annua ssp. reptans** Control in Bentgrass Greens

All rates are lb ai/a

Applications: 10-12, 11-09, 03-04, 04-05

Cape Fear CC, 1998-99
Effects of Primo and Proxy on Tall Fescue Foliar Growth

Wk After Treatment

% Change in Clipping Weight

Nontreated
Primo 12 oz/a
Proxy 5 oz/M

NCSU Turf Field Lab, 1999
Effects of Primo and Proxy on Tall Fescue Quality

Turf Quality (1-9)

- Nontreated
- Primo 12 oz/a
- Proxy 5 oz/M

Wk After Treatment

NCSU Turf Field Lab, 1999
Effects of Primo and Trimmit 2SC on Perennial Ryegrass Foliar Growth

Sandhills Res. Station, 2000
Effects of Primo and Trimmit 2SC on Perennial Ryegrass Quality

Turf Quality (1-9)

- Nontreated
- Primo 22 oz/a + 4 wk
- Trimmit 1 pt/a + 4 wk
- Trimmit 2 pt/a + 4 wk
- Trimmit 3 pt/a + 4 wk

Wk After Initial Treatment

Sandhills Research Station, 2000
Rebound Effect of Type II PGRs

Caused by single or inconsistent applications
Growth surges above nontreated levels
Scalping an issue in warm-season turfgrasses
Effects of Primo on ‘Tifway’ Bermudagrass Foliar Growth (One App.)

% Change in Clipping Weight

Wk After Treatment

Nontreated
Primo 12 oz/a
Primo 8 oz/a

Fagerness & Yelverton
Crop Science 40:493-497
Effects of Primo on ‘Tifway’ Bermudagrass Quality (One App.)

Turf Quality (1-9)
- Nontreated
- Primo 12 oz/a
- Primo 8 oz/a

Wk After Treatment

Fagerness & Yelverton
Crop Science 40:493-497
PGRs for Low Maintenance Areas

PGRs are also used in utility turfgrasses and hard to mow areas such as:

- Ditches
- Roadsides
- Steep embankments

...for seedhead and vegetative growth suppression.
PGRs for Low Maintenance Areas

- Quality and aesthetics not top priorities
- Discoloration usually tolerated
- Type I PGRs are products of choice
PGRs for Low Maintenance Areas

Type I PGRs

- Inhibit cell division (mitosis) of leaves and stems, causing top growth to slow or stop for several weeks
- Usually effective on seedhead suppression
- Can cause phyto due to slowed growth
- Work quickly (4 to 10 days) and last 3 to 4 weeks
Royal Slo-Gro

Apply to tall fescue or bahiagrass stands at least 3 years old

3 pounds active ingredient per acre (lb ai/A)
Embark 2-S

Apply to tall fescue up to 0.5 lb ai/A
Apply to common bermuda up to 1 lb ai/A

A nonionic surfactant (NIS) will enhance suppression but also increase phytotoxicity.
Embark 2-S

Embark 2-S and Embark Lite are Type I exceptions in that they do have a fit in certain high maintenance turfgrass areas.

Used to suppress *poa annua* seedheads from late winter to early spring in ryegrass overseeded bermudagrass at 0.125 lb ai/A and in St. Augustinegrass at 0.25 lb ai/A
Bahiagrass Seedhead Suppression

- Roundup Pro 0.2 lb ai/A
- Plateau 0.031 lb ai/A
- Oust 0.02 lb ai/A

Roundup Pro and Oust applied to stands at least 3 years old
Plateau requires a NIS (0.25% v/v)
Touchdown Pro

0.09375 to 0.1875 lb ai/A rate suppresses…

- Ryegrass
- Kentucky bluegrass
- Fine fescue
- Tall fescue

NIS or ammonium sulfate enhances performance
Touchdown Pro

0.14 to 1.5 lb ai/A rate suppresses dormant or actively growing...

- Bermudagrass
- Bahiagrass
Telar DF and Escort

Suppress tall fescue and bluegrass stands

- Stands must be at least 1 year old
- Can be tank-mixed with Embark 2-S

Telar DF + Embark applied at 0.012 + 0.125 lb ai/A

Escort + Embark applied at 0.009375 + 0.01875 lb ai/A to 0.03125 + 0.0625 lb ai/A
Summary

- Type II PGRs are utilized in high maintenance turfgrass areas where appearances are important.
- Type I PGRs are utilized in low maintenance turfgrass areas for seedhead and growth suppression where mowing may be prohibitive.
- There are exceptions, read the labels carefully.