Creative Uses for Plant Growth Regulators

They offer more advantages than growth reduction.

by NICK CHRISTIANS, Ph.D.

MY POSITION as a university educator has led to many opportunities over the years to speak to the general public about lawns. Whenever I speak to people who have little knowledge of turf management, I can always expect one question: "Is there anything that I can spray on my lawn so that I won't have to mow?"

Not having to mow has long been a dream of both the Saturday morning novice and the professional turfgrass manager. While the answer to the above question is a simple "no," there are a number of compounds that have the ability to slow the growth of grasses and consequently reduce the mowing requirements. This becomes particularly important on the golf course during periods of rapid growth such as in the spring for cool-season grasses and summer for warm-season grasses.

Table 1
Plant growth regulators that have been labeled for use on turf.

Common Name	Trade Name
Amidochlor	Limit
Chlorflurenol	Maintain CF125
Endothal	Endothal
Ethephon	Ethrel, Proxy
Flurprimidol	Cutless
Maleic hydrazide	Royal Slo-Gro
Mefluidide	Embark
Paclobutrazol	TGR, Turf-Enhancer, Trimmit
Trinexapac-ethyl	Primo MAXX

PGR Classification and Overview

Table 1 contains a list of both past and current plant growth regulating compounds (PGRs) that have been labeled for use on turf. The system by which PGRs are classified is undergoing change. The original system divided the compounds into two categories, Type I and Type II.[30]

Type I compounds are foliarly absorbed and inhibit cell division in the plant meristem.

Type II materials are usually crown and root absorbed. They suppress growth through the inhibition of gibberallic acid (GA), a naturally occurring plant hormone that reduces cell elongation. The Type II materials, which are also known as the GA inhibitors, include flurprimidol, paclobutrazol, and trinexapac-ethyl.

Most of the Type I PGRs are excellent seedhead inhibitors. Mefluidide is particularly well known for its ability to stop seedhead formation. Maleic hydrazide is also very effective at stopping seedhead formation. Both compounds tend to be somewhat phytotoxic and have limited use on high-maintenance turf. However, they are quite useful on low-maintenance turf such as roadsides. Mefluidide also is used to inhibit *Poa annua* seedhead formation in golf course turf. *Poa annua* seedhead suppression is difficult because it requires very precise applications of mefluidide and a thorough understanding of how the grass will react.

Type II compounds are usually less phytotoxic, although they also can cause some grass discoloration. The Type II compounds are not as effective in stopping seedhead formation as are the Type I materials, although they are quite effective at slowing growth and can be used to reduce the need for mowing if properly used. In the golf industry, one of the primary uses of flurprimidol and paclobutrazol has been the gradual removal of *Poa annua*. These GA inhibitors are known to have a greater inhibitory effect on *Poa annua* than on creeping bentgrass. With careful application and proper management techniques designed to discourage *Poa annua*, these materials may help increase the amount of bentgrass in the stand.

Trinexapac-ethyl is the newest of the Type II materials. Its advantage over the two older compounds is that it can be taken up through the foliage, whereas flurprimidol and paclobutrazol are primarily root absorbed. It has been used extensively on golf course fairways and to a limited extent on lawns to inhibit tissue growth and reduce the need for mowing. Trinexapac-ethyl has recently been labeled for *Poa annua* conversion programs.

The new classification system divides PGRs into classes A, B, C, and D.[31] Class A materials are GA inhibitors that interfere with GA production late in the biosynthetic pathway. Trinexapac-ethyl is the only Class A material at this time. Class B materials are those that inhibit GA early in the biosynthetic pathway. Flurprimidol and paclobutrazol are included in this class. Class C materials are mitotic inhibitors like maleic hydrazide, mefluidide, and amidochlor. Finally, Class D materials are PGRs that produce a phytotoxic growth regulating response at low levels and act as herbicides at higher levels. Two herbicides, chlorsulfuron (Telar) and glyphosate (Roundup), are examples of Class D compounds.

The newest material to reach the turf market is Proxy (ethephon), although it has been available for years in the floriculture and crop production markets. This material affects the growth of plants by releasing the plant hormone ethylene. It does not fit into any of the existing categories. The most striking effect is on Kentucky bluegrass, which undergoes some very unusual structural changes when treated with this product. Ethephon-treated bluegrass develops elongated internodes from the crown area and shortened leaves. The net effect is a stoloniferous Kentucky bluegrass that looks more like bermudagrass than bluegrass.[5, 6] As is the case with other PGRs, the effect of the ethephon varies with species. Work is presently being conducted at Iowa State University to characterize these responses on cool- and warm-season grasses.[14] The effect of Proxy on creeping bentgrass fairways has been variable in recent studies, and more work will be required to fully evaluate this product for fairway use.[13, 22]

Growth reduction is generally the goal in the use of PGRs, but a number of other creative uses have been developed for these useful compounds in recent years. Some of these uses have been the result of studies in the scientific community, but others have come about as the result of observations made by turf professionals in the field.

Poa annua Control

Poa annua control remains a serious problem for golf course superintendents around the world. One of the creative uses of PGRs has been to use them as part of a carefully structured integrated program to reduce *Poa annua* in golf turf. As was mentioned earlier, this generally involves the GA-inhibiting (Type II) materials and has been most effective on bentgrass/*Poa annua* fairways. The GA inhibitors do not kill the *Poa annua*, but slow its growth more than that of the bentgrass. Over time, this results in an advantage to the bentgrass and reduction of the *Poa annua*. While this program became widely used in the 1990s, results have been quite variable by location. Success depends on the skill of the superintendents in adapting the program to their particular situation. Results also may vary with the *Poa annua* biotype in the region.[2, 24]

Flurprimidol (Cutless) was the first material to be used in this way, and paclobutrazol (TGR, Turf Enhancer, Trimmit) became the most widely used in the 1990s. In the spring of 2001, a new program that involves applications of paclobutrazol (Trimmit) in spring and fall and trinexapac-ethyl (Primo-MAXX) during the summer was also introduced to the market.

Seedhead suppression of *Poa annua* may also be a goal in the use of PGRs. The Type II materials are only moderately effective in reducing seedheads. Mefluidide (Embark) is by far the best seedhead suppressor, but its use is difficult and discoloration of the turf can easily occur. Ethephon (Proxy) has recently been tested as a seedhead suppressor. It has proven to be quite effective on some *Poa annua* biotypes in California, but results have been more variable in other regions of the country.

Color Enhancement

From the beginning of PGR use on the golf course, superintendents have observed color changes when these products are used. With the earlier Type I materials, there was often a negative effect and turf discoloration was common. With the GA inhibitors, however, improvements in turf color are often observed. This is particularly true with trinexapac-ethyl (Primo), which often results in a darker green color of treated turf.[21, 18]

Reduced growth and improved color are a very beneficial combination on highly maintained turf. As is usually the case with PGRs, this response can be highly variable.

Overseeding

PGRs have been employed as a tool to improve overseeding of cool-season grasses into warm-season turf. The goal is to slow the growth of the warm-season grass without inhibiting the establishment of the cool-season seedlings.[1, 11] Timing is critical to prevent inhibition of the cool-season seedlings[16, 29] and results may be quite variable.[12] Trinexapac-ethyl (Primo) tends to be one of the best PGRs for this purpose because of its foliar absorption and its reduced likelihood of inhibiting the cool-season seed germination.[8] A critical factor in using trinexapac-ethyl for this purpose is that it be allowed to dry on the bermudagrass tissue before overseeding takes place.[17] Current label recommendations suggest applying Primo one to five days before seeding.

Water Use

PGRs reduce growth, but does this translate into a reduction of water use? Research in Australia[15] showed a 25% to 30% reduction in water use rate on tall fescue treated with trinexapac-ethyl. There is a great deal of interest in this subject, particularly in arid regions, and more work is needed on a variety of species.

Freezing Damage

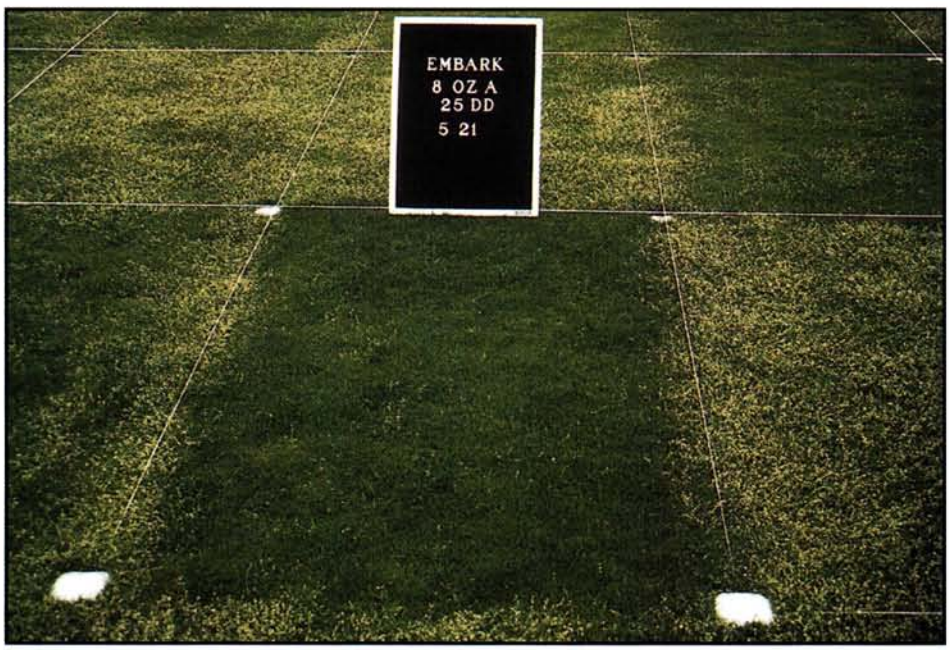
In northern regions, freezing damage can be a serious problem. PGRs slow growth, thicken cell sap, and may provide an antifreeze-like effect. Rossi and Buelow (1995) observed enhanced freeze tolerance of annual bluegrass treated with low rates of trinexapac-ethyl. However, Dunn *et al.* (1999) found no reduction in freezing damage on zoysiagrass treated with this product. Northern superintendents who often experience *Poa annua* loss during the winter may want to experiment with this idea.

Fungicides

One of the factors that limits fungicide efficacy is plant growth, or when the contacts are mowed off soon after application. PGRs tank-mixed with fungicides show promise in extending efficacy and in reducing the fungicide rates needed for disease control.[4, 25, 28, 32] Some PGRs may even directly suppress dollar spot on treated turf.[3]

Other Observations

Research has shown that PGRs can improve shade tolerance of certain spe-



Poa annua *contamination is a problem for golf course superintendents around the world. Embark is one plant growth regulator that effectively suppresses* Poa annua *seedheads, but there is potential for turf discoloration.*

cies, particularly zoysiagrass.[10, 20, 21, 26, 27] Trinexapac-ethyl is now being widely used for this purpose in the transition zone of the United States and throughout the Orient.

Finally, trinexapac-ethyl has been shown to reduce clippings, prevent scalping, improve establishment of new sod,[23] and stimulate tillering of Kentucky bluegrass being grown for sod.[21]

These are only a few of the potential uses for PGRs in the turf industry, and other innovative ideas are likely to follow. A number of these uses had their origin from observations made by golf course superintendents and other turf professionals working with the materials in the field. Those with other creative ideas are encouraged to share them at meetings or on-line so that they can be further developed and tested.

The product works. A Poa annua*-infested sod strip was untreated before it was used down the center of a golf course fairway. The strip stands out amongst fairway turf that had been treated to suppress* Poa annua *seedheads.*

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