Knowing how and when to use growth regulators can make a difference on your golf course.

Growth Regulators — New Tools for the '80s?

by STEVE M. BATTEN
Agronomist, Southeastern Region, USGA Green Section

GROWTH REGULATORS are not new. Almost 50 years ago plant scientists found they could actually change and often control the growth patterns of many plants by applying small amounts of certain organic chemicals. A new frontier had opened. It was an agricultural miracle that continues today.

In those early years, growth regulators were widely used to control broadleaf weeds on lawns and golf courses. Since then, gradually, subtly, scientists developed even newer compounds, and these are now capable of controlling the growth of grasses and landscape plants, chemical edging, seed head suppression, and retardation of not only broadleaf weeds but grassy weeds as well. Highway departments used them to suppress growth on embankments and steep slopes, and other commercial turf interests soon followed suit. But the acceptance of growth control agents on golf courses has been slow. Understandably, golf course superintendents have been reluctant to slow grass growth on the same general areas they are being paid to grow quality turf for golf.

Now, even that may be changing.

Continuing research, particularly during the last five years, has cleared the air for a better understanding of the limitations and effectiveness of growth regulators on fine-bladed turfgrasses. The trick to their successful use is in a basic understanding of their selectivity among grass species and their mechanical action on plants. In basic terms, this means the successful golf course superintendent should learn all he can about these new management tools and then put them to work.

Growth regulators can either stimulate or suppress shoot growth, root growth, or tillering effects of a plant. The most commonly applied growth regulators on golf courses are those that suppress shoot growth. These are maleic hydrazide (Slo Gro) and mefluidide (Embark). On the other hand, a growth regulator that stimulates vertical shoot growth is gibberellic acid. It had even been used to grow deeper rough in preparation for a U.S. Open Championship some years ago.

AS A GROUP, maleic hydrazide and mefluidide are often referred to as "growth inhibitors." This is because the turfgrass height is not altered during the period of suppression. In reference to the mechanics of action, maleic hydrazide and mefluidide suppress turfgrass shoots by inhibiting cell elongation.

More important than how they work, however, both are primarily absorbed by the leaves. In order to achieve the best possible inhibition, as much leaf surface as possible should be present at the time of application, and dead leaves and thatch should be removed. Timing of application, when the turfgrass is actively growing, such as in the spring, will allow for good translocation. Likewise, application after a rain or onto irrigated turfgrass will also improve translocation.

Scheduling of mowing prior to or after application can be critical. Because growth regulators are not instantly translocated, some manufacturers suggest mowing seven to 10 days after application in order to remove any flush of growth observed during the first week. This is especially the case with maleic hydrazide. Common sense should be exercised in not removing too much leaf material after application.

If the turf must be mowed prior to application, a good rule of thumb is not to mow any sooner than two days before the growth regulator is applied.

ALL OF THE growth regulators mentioned above can cause discoloration. For example, mefluidide has the ability to darken shoot color. Maleic hydrazide can cause yellowing. The effects of different growth regulators vary on different turfgrass species and on their cultivars as well.

Kentucky bluegrass discoloration is more likely to be apparent with maleic hydrazide than with mefluidide. Kentucky bluegrass also requires a much lower application rate of mefluidide than bermudagrass to get the same amount of shoot suppression. On the other hand, bermudagrass is more sensitive than bluegrass to maleic hydrazide. Furthermore, the fine-bladed improved bermudagrasses are usually more sensitive to growth regulators than the more coarse common types.

Discoloration can make a golf course superintendent humble if the chemical regulators are improperly applied to conspicuous turf areas. To avoid this embarrassment, first experiment with the suggested label application rate on an out-of-the-way area. Fitting the right growth regulator to your turfgrass condition can be accomplished simply by contacting a technical representative of the manufacturer. Then, one must be sure to apply the right material at the right rate to the targeted turfgrass species. Remember, these color changes depend on the turfgrass species and application rates, and you are in control of this operation.

AN EXPERIMENTAL group of growth regulators are presently being evaluated on warm- and cool-season turfgrasses. These growth regulators inhibit the formation of gibberellic acid in plants and thus suppress cell elongation. By governing the actual rate of plant growth, they are considered true growth regulators and not growth inhibitors. Their ability to suppress growth can be reversed by applying gibberellic acid. Therefore, they may become useful for manipulating different levels of retardation.

Two of these experimental growth regulators are paclobutrazol (PP 333) and flurprimidol (EL 500). EL 500 has been given the trade name Cutless.™ The main difference in these two and the growth inhibitors previously described is that they allow a continued but very much retarded lateral stolon growth. A distinct shortening of the internodes causes a witch-broom effect or multiple clustering of shortened leaves. It has even been noted that bermudagrass treated with EL 500 can have a more measured reduction in shoot height than that observed at the initial mowing prior to application.

Another difference is that these growth regulators are primarily absorbed by the roots. This could be a real plus on fine-bladed turfgrasses where granular formulation could be applied. In order to enhance root absorption, irrigation would also be necessary.

Although most species of turfgrass and landscape plants can be suppressed, there is a distinct difference in tolerance to PP 333 and EL 500 among species. Utilizing these tolerance differences, these compounds could be exciting new tools for managing weed populations and multi-species turfgrass sites.

The most common use of growth regulators at present is the reduction of mowing time on hazardous slopes. Some manufacturers suggest that mowing time can be reduced as much as 50 percent over a five- to eight-week period. Even though growth regulators are expensive to initially purchase, they do have great potential for saving mowing costs.

Another factor beyond cost is in equipment and personnel safety. There is no merit in exposing dangerous equipment such as rotary mowers to steep embankments any more than necessary. In this regard, much safer control of vegetation along drainageways or rough terrain can be possible.

Chemically edging the grass at the base of trees holds a great potential for growth regulators. If the proper application rate is used, the turfgrass will remain green and very acceptable for play. Another obvious advantage is less mower damage to the tree trunks. For this type of chemical edging, regulators should be selected that are primarily shoot and not root absorbed.

Within recent years, a great deal of concern has been given to chemically edging sand bunkers. Mefluidide has been successfully used for this purpose on cool-season turfgrasses. Several research studies are continuing at state universities for use of mefluidide alone, or in combination with EL 500. The objective of these studies is to increase the residual effects of shoot suppression.

SINCE GROWTH regulators are expensive, weed control is usually considered a fringe benefit. Realistically, weed control on areas where growth regulators have been applied is extremely important in order to maintain an acceptable appearance. Fortunately, many fast-growing broadleaf weeds such as white clover (*Trifoloum repens*) and oxalis (*Oxalis stricta*) are easily suppressed.

Rendering weeds to be less competitive is the basis for most weed control efforts with growth regulators. Research is being conducted on the timing of spring and fall applications of mefluidide and EL 500 in the northeastern United States for selective retardation of annual bluegrass in Kentucky bluegrass. On the other hand, in the Midwest, late spring applications of mefluidide at low rates have actually improved the summer vigor of annual bluegrass. Obviously, the timing of application and the rate

Characteristics of Growth Regulators

Commercially Available	Common Trade Name	Inhibition	Site of Plant Absorption	Comments
maleic hydrazide	SLO GRO (Uniroyal Chemical, Div. of Uniroyal, Inc.)	inhibits cell elongation and stops shoot	primarily shoot absorbed, some root absorption	for use on cool-season turfgrass
mefluidide	EMBARK (3M Agricultural Products, Div. of 3M)	same as above	primarily shoot absorbed	warm- or cool-season turfgrasses, bermudagrass required higher application rate than cool-season species
Experimental	**Experimental Number**	**Inhibition**	**Site of Plant Absorption**	**Comments**
flurprimidol	EL 500 (Cutless™) (Eli Lilly Laboratories, Div. of Elanco Products)	inhibits production of gibberellic acid and retards cell elongation	primarily root absorbed, some shoot absorption	presently being evaluated on both warm- and cool-season turfgrasses
pactobutrazol	PP 333 (ICI Americas, Inc.)	same as above	primarily root absorbed	same as above

applied can have an entirely different effect on weed control.

In California, kikuyugrass has been a target of growth retardation in bermudagrass turf. Altering turfgrass species by selective retardation has drawn considerable interest and opens the door to future research.

One of the most important characteristics of maleic hydrazide and mefluidide is their ability to impair flowering and seedhead production. This has led to their use in suppressing annual bluegrass in Kentucky bluegrass turf. Application rates of mefluidide for annual bluegrass seedhead suppression are less than half that suggested for suppression of Kentucky bluegrass alone. Thus, the manufacturer's recommendations this year will include annual bluegrass seedhead suppression. It is, in effect, a form of weed control.

Taking advantage of seedhead inhibition characteristics, many combinations of experimental growth regulators are constantly being tested for seedhead suppression on both warm- and cool-season turfgrasses. At Cornell University, an interesting study is underway to suppress annual bluegrass seedheads with multiple applications of Aqua-Gro, a commonly used wetting agent. The technique is patent pending, and the results are very positive to date. Other materials, including new fungicides with growth regulator properties are also being evaluated for seedhead suppression.

In Southern California, maleic hydrazide has been applied to bermudagrass fairways in the fall for shoot suppression prior to overseeding perennial ryegrass. Likewise on Kentucky bluegrass in the northeastern United States, mefluidide has been effectively applied prior to overseeding in the fall to renovate an existing bluegrass or ryegrass turf. In the Southeast/Southwest, the use of growth regulators prior to overseeding has also been suggested, and there does exist the possibility of spring applied growth regulators to aid in the transition zone in the southern part of the United States. Clemson University is investigating this approach and reports some success, although further investigations will be necessary.

Embark™ used for annual bluegrass seedhead control in Kentucky bluegrass.

RESEARCH HAS significantly increased during the last four years in regard to growth regulators and their effect on the physiology and development of turfgrass. For example, at North Carolina State University, evaluations are underway in regard to seedhead development and the effects of dormancy and root growth. Fertilizer interactions are being studied at Penn State. At Purdue, the University of Rhode Island, and Cornell University, the effects of growth regulators on annual bluegrass control and their effects on many other species of cool-season grasses are the main objectives of research. Across the Southern states, Auburn, Clemson, Mississippi State, Texas A&M, and the University of Florida have all taken interest and initiated studies on the new compounds that inhibit gibberellic acid formation.

Some of the most interesting research is being done with the new growth regulators and their effect on reduced water use in turfgrass management. Texas A&M University has been investigating EL 500 for this purpose on warm-season turf. Field studies are being evaluated with the use of weighable lysimeters (weighable containers) to determine water use rate. EL 500 has shown promise. In theory, PP 333 may also be used for this purpose, since its mechanics of action are very similar to EL 500. Interest has also been shown by several major northeastern universities to initiate similar research on cool-season turfgrasses. This concept of water use retardation may mean a new dimension for the use of growth regulators in the 1980s.

Research continues to open new doors to knowledge. Growth regulators are increasingly becoming management tools for the golf course superintendent. Now is the time to investigate these new tools under your conditions. Do it today. The experience and knowledge you gain will unquestionably find a place in your many tomorrows.