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IN THIS ISSUE



# Growth Regulators and *Poa annua*

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The use of growth regulators for various aspects of managing turf has increased greatly in the last 10 to 15 years. This increase has occurred as a result of an expanded number of product choices, research into potential uses, and an experience base of successes among practitioners.

## Early uses

The earliest uses (1960's) of plant growth regulators on turfgrasses were primarily for growth and seedhead reduction of amenity grasses, mostly along roadsides. Sites that were hazardous to mow, waste areas, and those that only required mowing because of tall seedheads were the principal targets for growth regulator use. Early products, such as maleic hydrazide, provided good growth and seedhead suppression, but often caused reduced root growth and foliar discoloration. These undesirable side effects were often considered acceptable as the turf usually recovered and the lower level of quality could be justified by the savings realized

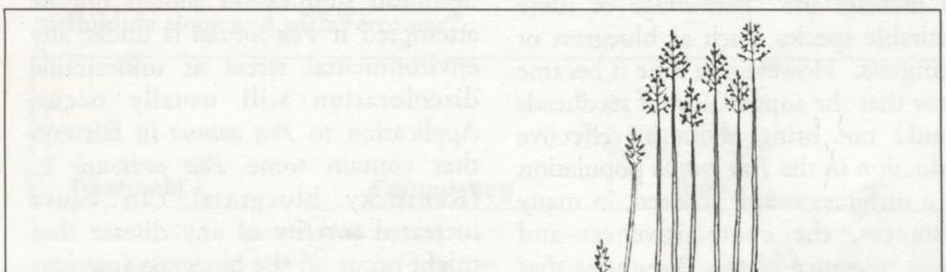


**Figure 1. Timing of plant growth regulator applications.**

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from the reductions in labor, equipment, and fuel for mowing. However, such undesirable side effects were not generally acceptable on most fine turf areas. It was not until the early and mid-seventies that growth regulator use on fine turf began to substantially increase. New chemistry was being introduced (chlorflurenol and mefluidide) that was less harsh, from an injury standpoint, while still providing reasonably good growth and seedhead suppression. These materials all provided growth suppression primarily through a reduction in cell division (mitotic inhibition). The reduction of cell division is the principal reason that such inhibitors can so effectively suppress seedhead production.

## Fine turf applications *(Poa annua)*

*Poa annua*, which establishes and perpetuates itself primarily through seed production, became an early target for application of the newer mitotic inhibitors. Initially it was thought, that by significantly suppressing seedheads, *Poa annua* would eventually become less competitive and the turfgrass population could be manipulated to increase the percentage of more desirable species, such as bluegrass or bentgrass. However, in time it became clear that the suppression of seedheads would not bring about an effective reduction in the *Poa annua* population of a turfgrass sward. Indeed, in many instances, the competitiveness and stress tolerance of the *Poa annua* that had been previously treated with growth regulators increased throughout the season. This phenomenon can result in a status quo, with regard to the distribution of grass population, or even to an increase in the amount of *Poa annua* in the stand. Therefore, the use of mitotic inhibitors has evolved to the point where many golf course superintendents that are managing predominately *Poa annua* turf apply such products (primarily mefluidide) to enhance the quality of *Poa annua.*

Some roadside applications continue to be made in various states and research for such use has continued, but most recent research emphasis using mitotic inhibitors has been focused on *Poa annua* management. For the most part, the application of mitotic inhibitors to *Poa annua* is for seedhead suppression to improve turf quality. Any increased tolerance to environmental stress that might be realized is usually considered to be a bonus in the overall scheme of things.

## Seedhead suppression

Successful seedhead suppression is the result of proper timing. Applications must be made after complete "green-up" in the spring (usually after the third mowing) and before the majority of seedheads have emerged (Fig. 1). If applications are made before complete "green up" there can be a delay, as new budshoot development will be suppressed. If application timing occurs after seedhead emergence has begun, poor overall suppression will result. Seedhead suppression should not be attempted if *Poa annua* is under any environmental stress as undesirable discoloration will usually occur. Application to *Poa annua* in fairways that contain some *Poa pratensis* L. (Kentucky bluegrass) can cause increased severity of any disease that might occur on the bluegrass (particularly leaf spot). If the rough is a Kentucky bluegrass/fine fescue (*Festuca* spp.) mixture, special care should be taken to avoid application to the rough, again because of the potential for worsened disease conditions. While it is highly unlikely that mitotic inhibitors predispose the turf to disease or decrease inherent resistance, the suppressed growth reduces the ability of treated turf to produce new leaves, which would be unaffected by the activity of any foliar pathogen. Properly calibrated spray equipment is critical for successful applications, and the use of foam marking systems to prevent skips and excessive overlap is recommended. When properly timed and applied, the level of seedhead suppression should equal or exceed 90% (Fig. 1).

Some golf course superintendents add wetting agents (product choice does not appear to make any significant difference) in an attempt to increase the activity of mefluidide at lower rates. The lower rate (6 oz. product/acre) plus the wetting agent at label rate can maintain a high level of seedhead suppression, but with less turf discoloration (although turf discoloration is very slight and short term when mefluidide is used alone at the label recommended rate). Seedhead suppression generally lasts approximately four weeks, after which time the turf exhibits a "rebound" effect (slightly stimulated growth and enhanced color). This effect occurs at the time when untreated *Poa annua* has flowered and set seed, and is generally exhibiting decreased quality due to slowed growth and a slight loss of color (yellowing).

In recent years (late 80's and 90's) research emphasis with mitotic inhibitors has become more focused on seedhead suppression of *Poa annua* in putting greens. Again, the objective is to improve the quality of predominately *Poa annua* greens by reducing seedheads, and thus improving smoothness and ball roll. Although not currently on the use label of mefluidide, research has shown that a reasonably high level of seedhead suppression can be attained on close cut *Poa annua.* It appears that mefluidide applied at approximately 4 oz. product/acre tank mixed with 5 oz. of Ferromec®/1000 ft$^2$ can produce effective suppression without any undesirable side effects (Table 1). Although higher rates provide better suppression, undesirable discoloration can occur. At the time of this writing, it is uncertain as to whether application to greens will be submitted by the manufacturer for approval by the U.S. Environmental Protection Agency as a label amendment.

## Suppression via the limitation of gibberellin biosynthesis

In the 70's and early 80's, plant growth regulator chemistry expanded with the commercialization of compounds that suppressed growth primarily via the interruption of the plants ability to synthesize gibberellin (GA). GA is necessary for the normal elongation of cells; therefore, any reduction in the normal synthesis of this substance in the plant

**Table 1. Percentage of Poa annua seedheads compared to the untreated check from treatments of mefluidide alone and with Ferromec®.**

| Treatment | Formulation | Rate | Percent Suppressed 21 | 35 DAT |
|---|---|---|---|---|
| Mefluidide | 2S | 0.05 oz/m | 63 | 53 |
| Mefluidide | 2S | 0.1 oz/m | 93 | 90 |
| Mefluidide | 2S | 0.2 oz/m | 98 | 95 |
| Ferromec® | --- | 6 oz/m | 0 | 0 |
| Mefluidide + Ferromec® | 2S | 0.05 + 6 oz/m | 37 | 27 |
| Mefluidide + Ferromec® | 2S | 0.1 + 6 oz/m | 85 | 75 |
| Mefluidide + Ferromec® | 2S | 0.2 + 6 oz/m | 92 | 85 |
| Untreated Check | --- | --- | 0 | 0 |

results in suppressed growth (stunting or dwarfism). Cell division is not significantly affected; therefore, seedhead suppression is not as successfully accomplished by inhibiting GA as with the use of mitotic inhibitors. In fact, GA suppressors are used very successfully in small grains and rice production to enhance seed yield because of decreased lodging (the stalk of the seedhead grows shorter and thicker making it less susceptible to wind). Consequently, the use of GA inhibitor growth regulators for the purpose of *Poa annua* seedhead suppression is largely unsuccessful. However, GA inhibitor compounds have been found to differentially suppress the growth of *Poa annua* compared to other cool season turf species (particularly *Agrostis* spp.).

## Stand conversion

Most research using GA inhibitors has targeted mixed *Poa annua*-creeping bentgrass (*Agrostis stolonifera*) stands on both golf course fairways and greens. Applications are intended to increase, over time, the percentage of creeping bentgrass over *Poa annua* without significant discoloration of the *Poa annua*. The rate of success appears to be a function of the percentage of creeping bentgrass present when treatment is initiated. There should be enough creeping bentgrass (at least 35%) in the stand to provide the plant species with a basis for conversion. If bentgrass is not present in sufficient quantity, serious consideration must be given to managing the *Poa annua* as the desired species. Otherwise, an aggressive bentgrass overseeding program must be initiated; possibly in combination with a total vegetation kill using glyphosate (Round Up®). Killing predominately *Poa annua* fairways with Round Up®, followed by bentgrass overseeding, will often result in a mixed *Poa annua*-bentgrass stand that may only slightly favor bentgrass; however, this approach usually does provide enough of a bentgrass base for a conversion program to be initiated. Regardless of the starting point, it appears that perseverance is necessary as, while the conversion is steady, it is usually slow. Two applications per year, in the spring after seedhead production and in the fall just after *Poa annua* germination, can bring about a satisfactory conversion of a mixed *Poa annua*-creeping bentgrass stand in three to five years, depending on the amount of creeping bentgrass in the stand at the beginning. The spring application is timed to follow seedhead production because *Poa annua* becomes physiologically weakened due to the production of seed; coincidentally, creeping bentgrass is entering a time of the year when it becomes vegetatively aggressive and it continues that way throughout the summer as compared to *Poa annua.* The fall application is positioned after *Poa annua* germination because seedling *Poa annua* is more sensitive to GA inhibitors than are the mature plants; this is in addition to the fact that *Poa annua* plants, regardless of age, become more competitive against creeping bentgrass in the fall.

The scenario for conversion from predominately *Poa annua* to predominately creeping bentgrass follows the same protocol whether it is on fairways or greens. However, since greens typically have more of the perennial type of annual bluegrass (*Poa annua* var. reptans.), conversion ultimately results in a mixed creeping bentgrass-perennial annual bluegrass turf. This is the result of stoloniferous species having a competitive advantage over non-stoloniferous species when the sward is treated with GA inhibiting compounds.

## Conclusion

Growth regulators, therefore, can be used to effectively enhance *Poa annua* as a turfgrass or, depending on the mechanism of action, can create significant problems for *Poa annua* with respect to its ability to compete with other species (particularly creeping bentgrass). The most important thing is to maintain consistency with respect to the direction chosen for growth regulator use.

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