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EXCITING NEW DEVELOPMENTS IN TURFGRASS GROWTH MODIFICATION

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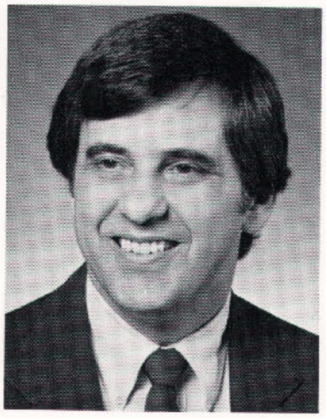


During the last several years, a renewed excitement in controlling the growth of turfgrasses has developed. This excitement has been triggered by the appearance of a number of experimental pesticides with unique modes of biological activity. In the simplest of terms, this mode of activity deals with the pesticides ability to interfere with or reduce the biosynthesis of gibberellic acid (G.A.) by turfgrass plants. Gibberellic acid is a plant growth hormone which when produced by the plant in normal quantities results in stem (internodal) elongation. If the quantity of GA is reduced, the amount of stem elongation that occurs is reduced. This results in a more compact plant growing at a slower rate.

In order to appreciate the reasons for this excitement, one must recount past developments in this area and understand the difference between modifying plant growth and stopping it. Initial pesticide development efforts in this arena led to the commercialization of maleic hydrazide (MH) in the late 1940's and early 1950's by Uniroyal. MH used as a growth regulator on turfgrasses results in a stoppage of plant growth. The duration of this stoppage is dependent on the sensitivity of the turfgrass species treated and the rate of application. At certain rates MH is herbicidal on turfgrasses and can result in complete kill. Even at recommended rates, MH results in a phytotoxic response, discoloration and a possible thinning of the turfgrass stand. When the treated plants recover from this injury, they typically grow more rapidly than untreated areas.

Similar turfgrass response has occurred with later generation plant growth regulators. The most prominent of these have been chlorflurenol and mefluidide. Both compounds result in a stoppage of turfgrass growth and a phytotoxic response similar to that described for MH.

As a result of these properties, the use of these compounds has been limited to low maintenance utility type turfgrass areas such as

(Continued on page 19)

Table of Contents

(Continued from page 1)
along highways and roadsides. Well maintained, high quality turfs such as desired on golf courses, home and industrial lawns, parks, and cemeteries cannot tolerate the undesirable effects inherent in pesticides that stop plant growth.

Turfgrasses grown for their aesthetic value or to maintain a high quality recreational surface must continue to grow in order to provide a dense, healthy stand. A pesticide that allows growth to continue but results in a reduction in stem elongation and a more compact plant, offers significant opportunity for managers of high quality turfgrass areas.

One such class of pesticides **currently under experimental development** by Elanco Products Company is the pyrimidine methanols. Two members of this group, in particular, will be discussed to illustrate the potential opportunities they may bring the turfgrass manager.

Rubigan® Systemic Fungicide for Turfgrass Disease Control

One of the compounds is Rubigan (fenarimol, Elanco Products Company) and its primary biological activity is as a locally systemic fungicide. As a fungicide, Rubigan inhibits the biosynthesis of the fungal sterol, ergosterol. Turfgrass pathogens sensitive to Rubigan's mode of action include those causing dollar spot, large brown patch, *Fusarium* blight, striped smut and the snow mold causing pathogens. Several other turfgrass pathogens have also exhibited sensitivity to Rubigan and research efforts are continuing to fully define application rates and timing.

During the course of the research and development of Rubigan as a turfgrass fungicide, a secondary biological effect was noted. This effect deals with the reduction of the biosynthesis of GA in an annual weedgrass commonly associated with golf course putting green culture. This species is annual bluegrass *(Poa annua)*. At higher fungicidal application rates, Rubigan acts to reduce the biosynthesis of gibberellic acid in the true annual species of *Poa annua*. When Rubigan is used on cool season turfgrass areas where *Poa annua* survives throughout the summer, continuing applications over several seasons in a preventive fungicide program can gradually reduce *Poa annua* populations while competing perennial turfgrass species increase in the population.

A shift in population dynamics such as this can only occur when the competitive advantage normally enjoyed by *Poa annua* is altered to favor the other competing species. Rubigan's mode of activity is expressed in *Poa annua* at significantly lower dosages than in perennial turfgrass species such as creeping bentgrass, perennial ryegrass, and Kentucky bluegrass. This selective response enables the perennial turfgrasses to grow uninterrupted at their normal rate while *Poa annua's* competitive edge is reduced or eliminated. Cultural practices and environmental conditions which favor *Poa annua's* growth and survival will obviously impede this population shift.

Rubigan's biological activity in *Poa annua* not only occurs on existing plants treated fungicidally but can also effect *Poa annua's* seedling vigor when germination occurs during the late summer or early fall. Rubigan's ability to significantly reduce *Poa annua's* seedling vigor will depend on the total quantity of compound applied during the summer disease control program. Residual quantities of Rubigan remaining in the *Poa annua* germination zone plus continuing fungicidal applications will reduce *Poa annua* seedling vigor and competitiveness by the same biological mechanism of action as already described. There is no single quantity of Rubigan that can be expected to result in the desired growth modification. This is due to the extreme variability that exists in the *Poa annua* species itself, varying environmental conditions, cultural practices, and soil conditions. Minimum amounts necessary each season are generally in the range of 2 to 3 ounces of formulated product (50% Wettable Powder) applied over the course of the dollar spot control application season. It must be emphasized here, that Rubigan should only be used as recommended for turfgrass disease control. The potential to reduce *Poa annua* populations must be recognized as a secondary benefit and just part of an ongoing *Poa annua* management program.

As an example, Rubigan 50W applied in a preventive disease control program at 0.4 ounces/1000 sq. ft. every 3 weeks beginning on June 1st will result in the following additive totals over the course of the spray season.

The above disease control program will provide excellent control of dollarspot under all disease pressure situations and good control of brownpatch under low to moderate pressure from that pathogen. If environmental conditions occur which are favorable to high disease incidence of brownpatch, an effective fungicide for its control should be tank mixed as appropriate with the Rubigan.

	Rubigan 50W/1000 Sq. Ft.	
Application Date	Quantity Applied Per Application	Total Amount Applied To Date
June 1	0.4 ounces	0.4 ounces
	+	
June 22	0.4 ounces	= 0.8 ounces
	+	
July 13	0.4 ounces	= 1.2 ounces
	+	
August 3	0.4 ounces	= 1.6 ounces
	+	
August 24	0.4 ounces	= 2.0 ounces
	+	
September 14	0.4 ounces	= 2.4 ounces
	+	
October 5	0.4 ounces	= 2.8 ounces

Poa annua will likely begin its late summer-fall germination cycle during mid-August. At this time, in the example used above, the total amount of Rubigan 50W applied is 1.6 ounces. It should be apparent that to enhance Rubigan's growth effect on the *Poa annua* seedlings, applications should continue into the early fall.

It should be emphasized that reducing *Poa annua* populations in this manner is a gradual process. Success will depend on a number of factors. Several of the more important ones include the following:

1. Presence in the turfgrass population of a sufficient percentage of aggressive perennial turfgrass cultivars to encroach on the competitively disadvantaged *Poa annua* plants.
   Note: This approach to *Poa annua* conversion should not be attempted on turfgrass areas dominated by *Poa annua* (greater than 75% of population) until sufficient numbers of perennial plants have been introduced into the turfgrass stand through sound overseeding practices.
2. Utilization of cultural practices designed to discourage *Poa annua* growth and favor the growth of perennial species. These include, but are not limited to, the following:
   a. Judicious use of irrigation based on the physiologic needs of the perennial species in the turfgrass population.
   b. Fertilization timed to enhance perennial grass growth.
   c. Management of soil conditions to improve internal drainage and soil aeration and aviod any disturbance of the turfgrass surface during primary *Poa annua* germination periods.
3. Continuation of the program over several consecutive growing seasons. The circumstances that resulted in the *Poa annua* problem did not lead to the overnight appearance of this weed species. It is not reasonable to expect that this trend can be reversed overnight.

This example of the utilization of the growth modifying properties of a new **experimental pesticide** illustrates a secondary benefit from the proper use of a turfgrass fungicide.

To more dramatically illustrate the opportunities that exist in modifying turfgrass growth, an examination of the biological activity of another member of this same family of chemicals is appropriate. Whereas, the biological activity of Rubigan is dominantly fungicidal with a low level of growth modifying potential, the biological activity of Cutless™ (flurprimidol, Elanco Products Company, A Division of Eli Lilly and Company, Indianapolis, Indiana) is dominantly growth modifying in nature with little or no fungicidal activity.

Cutless™ — Turfgrass Growth Modifier

Cutless works in turfgrass plants in the same manner as Rubigan works in *Poa annua*. Cutless, however, reduces the biosynthesis of gibberellic acid in turfgrass plants at much lower application rates and across a broad range of perennial as well as annual plant species. When Cutless is applied to well maintained, actively growing stands of turfgrass (particularly golf course fairway turfs) the following responses have been noted:

1. A general reduction in the rate of growth without a stoppage of growth and a general reduction in plant height.
2. An increase in plant tillering and lateral spread resulting in an overall improvement in stand density.
3. A reduction in mowing frequency and clipping volumes.
4. A darkening of normal green coloration.
5. Improvement of the turfgrasses' tolerance to moisture stress.

Once again, it is important to emphasize that the primary biological activity of Cutless is as a growth modifier for desirable perennial turfgrass species. It's potential benefits to the turfgrass manager are listed above while its effect on *Poa annua* are strictly secondary in nature. Were *Poa annua* not to exist, the benefits of Cutless use on a golf course fairways would still be as attractive.

Along with the largely positive benefits associated with Cutless' use, a few necessary precautions should also be noted. Since the turfgrass stand is growing at a much reduced rate, the potential for damage from some turfgrass disease organisms or foliar feeding insects may be increased. Normal preventive pesticide programs targeted at either occurrence will alleviate any concerns. Cutless should only be used during periods of active plant growth. There can be no management benefit to further decreasing the plant's growth during periods of normally reduced growth.

As one might expect, the same growth response described for *Poa annua* treated with Rubigan occurs more dramatically when *Poa annua* is treated with Cutless. In fact, one of the primary areas of Elanco's development efforts with Cutless are targeted at the conversion of *Poa annua* infested golf course fairways to fairways comprised largely of more desirable perennial turfgrass species.

Unlike the fungicidal use of Rubigan, Cutless applications in *Poa annua* infested fairways are timed solely to reduce the competitiveness of *Poa annua* during its two most aggressive growth periods. These occur in the early spring and fall of the year. Application rates for this facet of Cutless' activity are lower than those suggested for general turfgrass growth modification of perennial turfgrass species. Because Cutless is considerably more active than Rubigan, *Poa annua's* response to treatment is more dramatic. Plant growth is severely reduced, resulting in a chlorotic appearance and a slight browning of *Poa annua's* leaf tips. Treatment also results in a delay in the flowering of *Poa annua* and a retention of its seedheads for a longer period than normal. The retention of the seedheads is due primarily to failure of the flowering stem to elongate sufficiently to be removed by mowing. The combined visual impact of these responses is greater on areas containing high *Poa annua* populations.

It is important to note that while treated *Poa annua* plants are severely stressed by this treatment, they do not die. During the period of Cutless growth reduction of *Poa annua*, competing perennial turfgrasses continue to grow more aggressively and in the absence of *Poa annua's* normally aggressive growth are able to rapidly encroach on areas occupied by *Poa annua*.

Cutless also exhibits considerable potential for modifying cool season perennial turfgrass growth at application rates higher than those required to reduce *Poa* *annua's* growth and at similar rates on the hybrid bermudagrasses and other warm season turfgrass species where *Poa annua* is not a summer growing season problem. The benefits of this type of usage were listed previously but can generally be summarized to result in an overall improvement in turfgrass quality.

Emphasis must be made here that the most favorable growth modification results have been obtained when Cutless is applied to high quality, well maintained stands of turfgrass relatively free of coarse textured contaminant grasses. It should also be apparent that the general growth modification rates for cool season perennial turfgrasses should not be used on areas containing excessive quantities of *Poa annua* unless treatment is accompanied by an aggressive reseeding program.

There are obviously many variables associated with the proper use of a biological agent with the activities of Cutless. A considerable amount of research has been completed and additional field studies are underway and planned to fully characterize all aspects of Cutless' activity. This endeavor spans both the cool and warm season turfgrass species and will seek to utilize the observations and experience of professional golf course superintendents along the way.

In summary, the concept of controlling the growth of turfgrasses has long been an attractive goal. The goal has been extremely illusive due to the contradictory demands of a healthy, vigorous turf and any chemical that totally stops plant growth. A new generation of chemical tools is on the horizon and their ability to modify the way in which plants grow can put the control in the hands of the turfgrass manager where it belongs. When considering the future opportunities such developments may bring, old terms such as "growth inhibitor" or even "growth regulator" are no longer appropriate. Both carry the stigma of previous products that were not suited to use on the fine turfgrasses. This new generation should clearly be termed "Plant Growth Modifiers."

Editor's Note: Dr. A. Thomas Perkins was born in Youngstown, Ohio.

He attended Muskingum College for two years prior to transferring to Pennsylvania State University where he received his B.S. degree in Turfgrass Science (Agronomy) in 1964. He continued his education at Penn State, receiving his Ph.D. in Agronomy in 1969.

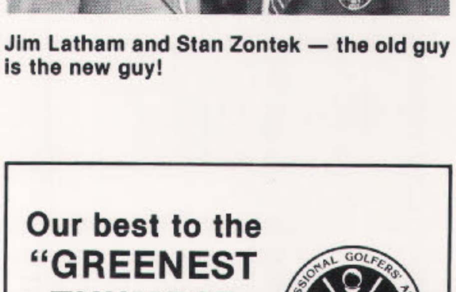
During his graduate program Dr. Perkins was a full time instructor in the Agronomy Department teaching golf course superintendents in training. After receipt of his doctorate, Dr. Perkins joined the resident faculty in the Turfgrass Science area.

In 1970, Dr. Perkins joined Lilly Research Laboratories as a Senior Plant Physiologist working in the area of new product discovery and development for the green industry. From that time through 1983, he has held several positions, all associated with the development of new pesticidal product for this market.

In 1984, Dr. Perkins assumed his current position as Manager of Technical Chemicals Sales and Market Development for Elanco Products Company.

BEST WAY TO WELCOME LATHAM? SUBSCRIBE TO USGA GREEN SECTION TAS FOR 1985!

Jim Latham is already settled in his Milwaukee office and looking forward to continuing the good work Stan Zontek gave to the Wisconsin golf course industry. The USGA office in Far Hills, New Jersey is taking applications for the 1985 Turf Advisory Service. Those who are past subscribers to this outstanding program of the Green Section will testify that it is easily the best bargain to be had in our business of managing golf course turf. The price is fair, the advice and counsel are solid, and you are able to select the time of the golf season you want the visit made. Let's show Jim the kind of support we feel, and make his first year with the Green Section in Wisconsin rewarding and successful!



Jim Latham and Stan Zontek — the old guy is the new guy!