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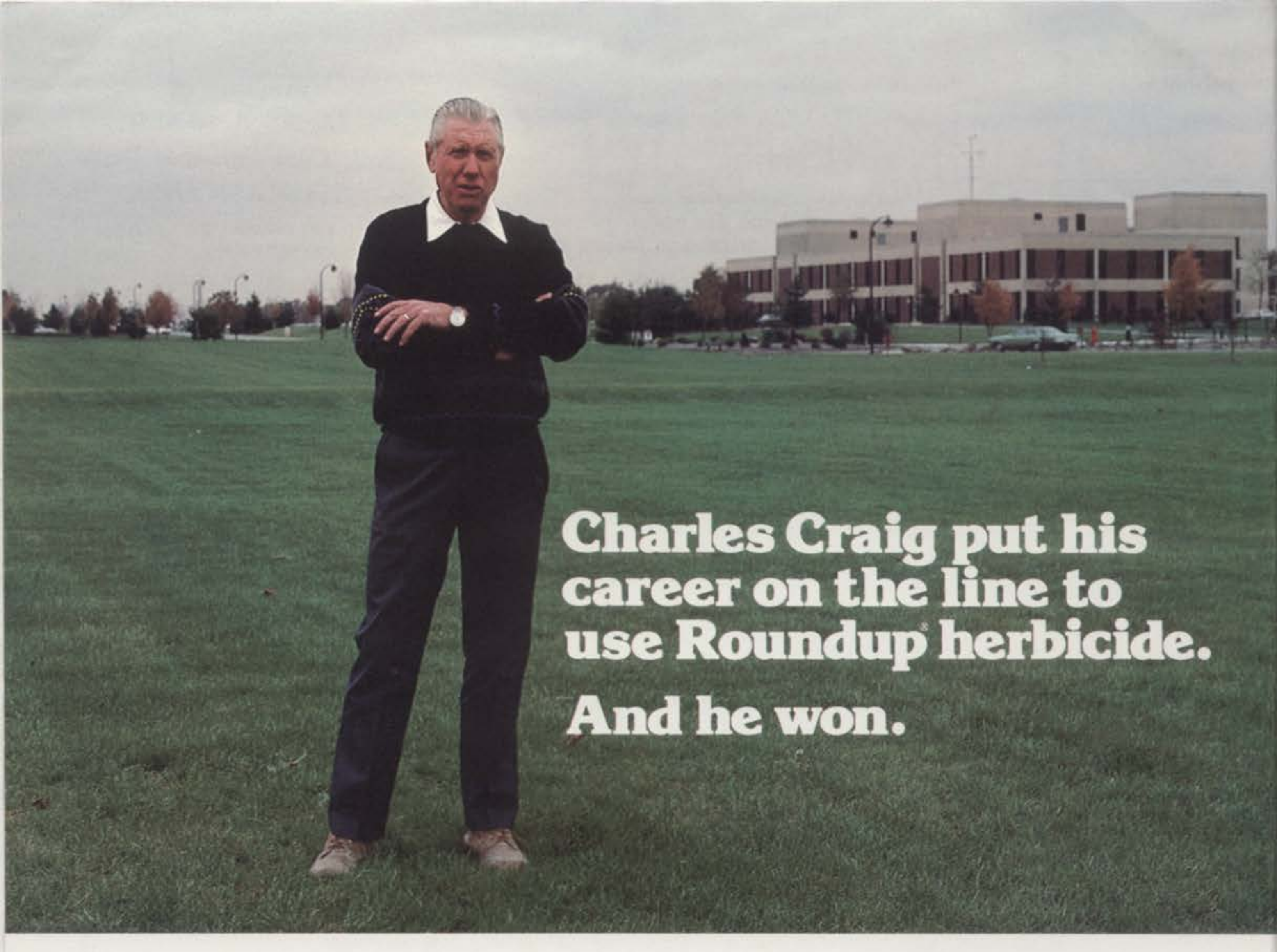

When Charles Craig decided to renovate 35 acres of this college campus with Roundup® herbicide in 1977, he knew that if it didn't work, he'd probably have to "hide under a rock."

But, fortunately, Charles didn't have to go into hiding because just 7 days after he applied Roundup he was able to reseed right into the dying grasses.

"Yes, I put my career on the line, but I felt all along that Roundup was going to work," Charles says. "There was no doubt in my mind."

As horticulturist for Mercer County Community College in Trenton, New Jersey, Charles Craig depended on Roundup for the broad spectrum control he needed for tough grasses like quackgrass, orchardgrass, tall fescue and others. And since Roundup has no residual soil activity, he was able to reseed in a matter of days.

"Seed germination was terrific, especially with the weather we had," Charles told us. "Everyone always says it looks nice."

Charles still uses Roundup for touch up jobs around cracks in the pavement, parking lots, buildings, tree bases and flower beds. Taking precautions against spray drift, Charles has no fear of harming surrounding vegetation with Roundup.

Charles Craig is convinced that Roundup works, and he has 35 acres of beautiful turf to prove it.

To see how it can work for you, reach for Roundup where you buy chemicals.

For literature, call 1-800-621-5800, or in Illinois, 1-800-972-5858.

Monsanto

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Editorial

"Things are seldom what they seem,
Skim milk masquerades as cream . . ."
Gilbert & Sullivan
H.M.S. Pinafore
1878

From time to time, this space will be made available so that others may express their viewpoints on particular topics. The following editorial was written by publisher Art Brown.

You may not be aware of the fact that the active ingredients given on pesticide labels will seldom match the actual amount in the container. The situation is much like the mileage claims made for new cars. Because certain vehicles are hand-picked, pre-tested, and then driven under optimum conditions, the MPG listed on the sticker is usually better than the public can really expect.

At the large chemical plants, label specifications pertaining to active ingredients are achieved when the manufacturing process proceeds exactly as it is supposed to. However, the amount of active ingredients in any given container is likely to vary somewhat because the chemical manufacturers, like you and I, cannot continuously produce at that level of perfection. A production manager at a chemical plant could probably spend hours explaining all of the things that can and do go wrong during the manufacture of pesticides. Although it is not their wish to "cheat" you, it should be kept in mind that you are not always "putting down" all the chemical you would like to.

There are occasional spot checks made by state agricultural departments and by EPA representatives. In a booklet released last summer, the findings of these spot checks revealed that more than 90% of the pesticide manufacturers were below label specifications on active ingredients.

While questioning state officials, I found that they tend to shy away from quoting percentages because they are constantly fluctuating. The officials' primary interest is whether the amount of active ingredients in the container is sufficient to do the job specified on the label. When the active ingredients do not perform sufficiently or when they are too far removed from what they should be, then the government will step in.

HOW DOES THIS AFFECT YOUR BUSINESS?

If you are working on a large job and the customer wants to make a chemical analysis of your tank mix, I recommend that you refuse. You should instead offer the customer the option of watching you load. Let him write down all the materials going into the tank, noting their weight, volume, and active ingredients. If the customer insists on a chemical analysis, it is far better that he analyzes the materials separately prior to putting them in the tank. With this approach, the customer can determine which, if any, of the products have less active ingredients than desired. And, best of all, you won't have to defend yourself from allegations that you didn't put enough product into the tank.

When you consider that spraying a lawn is essentially a hand operation which includes such variables as spray width, degree of overlap, varying speed, and occasional pressure variations, it becomes clear that guaranteeing chemical formulas in terms of parts per million is a foolish exercise, at best.

Art Brown
Publisher

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H. G. Lendle, of Liberty, Missouri, recently wrote to the "Organic Gardening" magazine to report that he has found a new way to dethatch his lawn. He uses stale beer from cans which have been left open overnight. The beer is applied with a hose-end sprayer at the rate of one quart per 1000 square feet.

Mr. Lendle reports that an application of beer, when the soil is warm and moist, results in the rapid decomposition of thatch. We don't know if this procedure really works, but it certainly gives rise to some interesting mental pictures. Can't you just see a "dethatching party"? One for you, one for the lawn!

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Septoria?

by Stephen Brown

In early July an unusual condition was noticed on many home lawns in northern Indiana, northern Ohio, and southern Michigan. The problem began as bleached patches of turf, often occurring near roads and driveways. The tips of individual blades died back in a pattern that looked very much like chemical burn. Many of the blades had tan lesions which resembled Sclerotinia Dollar Spot but lacked the brownish bands at the margins. As the situation progressed, the entire blade turned tan and small, black spots were apparent in the necrotic areas. Large patches of turf died and the affected areas became "crispy" dry.

Several lawn care companies were accused by customers of burning the lawns with soluble nitrogen and/or phenoxy herbicides. In a few cases, entire lawns were re-sodded by lawn care businessmen who became convinced that they had, indeed, caused the damage.

Although the symptoms closely resembled Septoria tip-blight, plant pathologists felt that the existing weather conditions and the locations of the outbreak precluded Septoria. Some pathologists hypothesized that the cool, wet spring which quickly gave way to a hot, dry period caused physiological problems in the affected plants.

Symptoms include tip blight, tan lesions, and eventual death of plant

Bluegrass and fescue are affected but "weedy" grasses appear resistant.

Affected lawn in Cleveland, Ohio

Same symptoms in Detroit, MI

The problem appears in small patches as well as large areas

Devastated home lawn in South Bend, Indiana

Stress areas along driveways and roads are often affected first

Or What?

Then, when it was shown that the conditions could be reproduced by putting damaged leaves in contact with previously healthy leaves, the Septoria theory gained some support. Ron Detwiler, lab assistant to Dr. Joe Vargas at Michigan State University, studied the small, black spots on the necrotic tissue and identified at least some of them as Septoria fruiting bodies. Later, Detwiler was able, on one occasion, to isolate Septoria in the laboratory. There is at this time, however, no conclusive proof that the Septoria pathogen was the cause of the problem.

Much work remains to be done on this problem. At this point, Dr. Vargas suspects that there is more involved than just Septoria. Because many of the affected lawns were under stress of some sort (drought, insects, or other diseases), Dr. Vargas believes that a complex of factors was responsible for the outbreak. Until another outbreak occurs, we will simply have to guess at what really happened.

Typical bleached appearance resembles chemical burn

Many homeowners thought drought was responsible

Home in Lansing, Michigan before treatment

Same lawn 17 days later, after fungicide application

Entire lawns were destroyed in mid-July

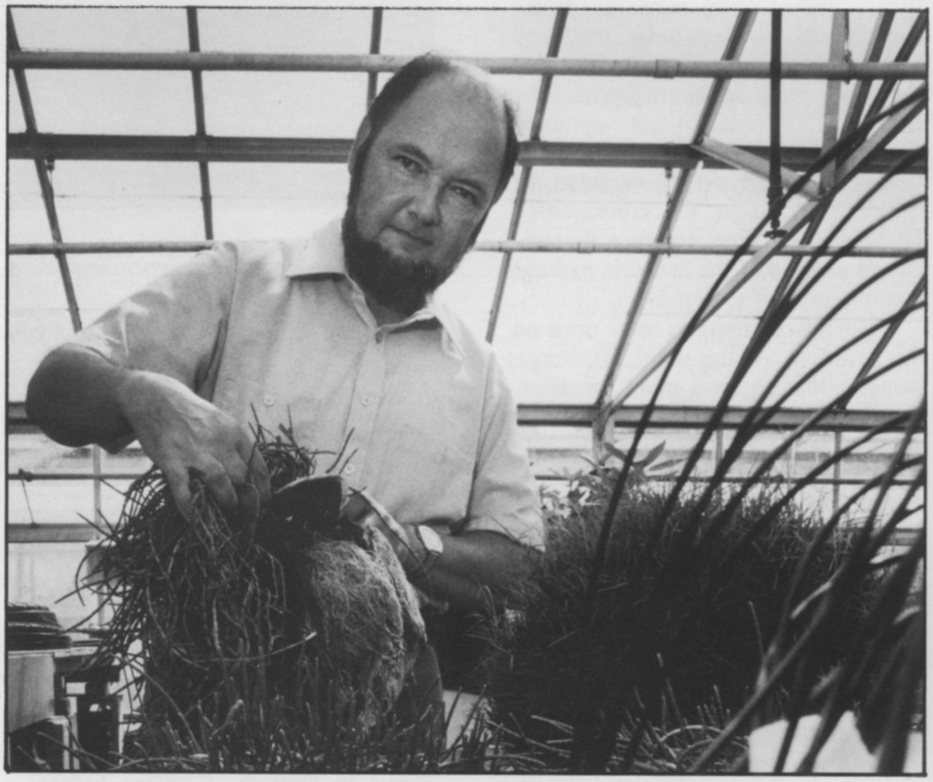
Back yard of Lansing home was seriously damaged

Back yard 17 days after fungicide treatment

Nutrient Balance and Turf Condition

by Richard J. Hull

Richard J. Hull is a Professor of Plant and Soil Science at the University of Rhode Island. He received his B.S. and M.S. degrees from the University of Rhode Island in agriculture and agronomy respectively and the Ph.D. in botany from the University of California at Davis. For five years, Dr. Hull studied the physiology of perennial weeds at Purdue University in Indiana. At Rhode Island, his research has concentrated on the nutrition of turfgrasses, woody ornamentals, and tidal salt marsh vegetation.



The Author

The fertilizing of lawn turf is often viewed as much an art as it is a science. The time of application, amount used, and the ratio of elements in the fertilizer are all factors to consider in developing a turf fertility program. Variation in nutrient needs of different turfgrass species might also be important but the evidence for this is not clear so it will not be considered in the present discussion. Climatic differences can also influence optimum fertilization practices but this is more likely to affect time of application than quantity or composition of fertilizer used.

In turfgrass management, as in most crop production systems, fertilization centers around the application of nitrogen (N), phosphorus (P), and potassium (K). Calcium (Ca) and magnesium (Mg) are normally applied in liming materials used to raise soil pH but the nutritional value of these elements should not be ignored. Calcium is essential for proper cell membrane function so the capability of grass roots to absorb nutrients is very much related to the available Ca in the soil solution. Magnesium is required as part of the green chlorophyll molecule but also functions along with P in the many energy transferring reactions in plant metabolism. Of the six macronutrients, only sulfur (S) normally is not applied as a fertilizer. However, a favorable response to S application is often observed especially when the grass has been managed under high N levels (Goss, 1974). Sulfur like N is required for protein synthesis and excess grass growth stimulated by high N may create a demand for S greater than it can be supplied by the soil solution.

The best use of the three fertilizer macronutrients for turf management is a subject of some controversy. In their review article, Juska, Cornman, and Hovin (1969) suggest that fertilizer formulations ranging from 20-10-5 to 10-10-10 can be used with good results on cool season turf. Some turf fertility programs are based primarily on the application of N. This apparent lack of specificity in turfgrass nutrient requirements is due in part to the subjective nature of evaluating turf performance. Unlike most crop plants where performance is based upon the quantity of a harvested yield, turf is evaluated on the basis of color, density, and ability to resist disease and mechanical injury. We have observed in our comparisons of Kentucky bluegrass cultivars

Nutrient Balance

that yield of clippings frequently does not correlate well with turf quality (Mehall & Hull, unpublished). Because turf is judged by very different criteria than most agricultural crops, it is perhaps not surprising that the nutrient requirements may also be different or subject to greater variation depending upon individual preceptions of quality. However, our results indicate that turfgrass nutrient requirements can be determined with greater precision than the above discussion would suggest.

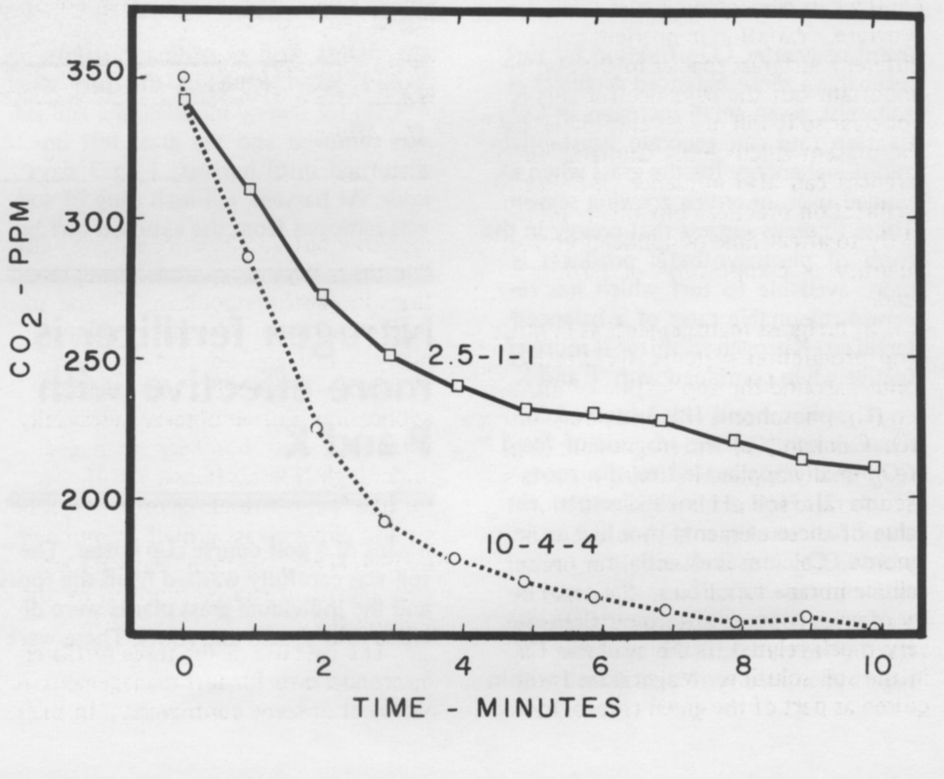
Nick Christians, in an earlier issue of **ALA** (Christians, 1980), outlined the functions of the major fertilizer nutrients and emphasized the interaction between nutrient elements in achieving quality turf. He concluded that lawn fertilizer programs should be based on more than N requirements, as is often the case, with full consideration given to P and K levels as well. Our findings at Rhode Island support his conclusions.

In 1966, a set of Merion Kentucky bluegrass field plots was established and subjected to four fertilizer formulations: N alone, N + P, N + K, and N + P + K. In 1970, each formulation plot was subdivided into three sub-plots consisting of three fertilizer rates: 2.5-1-1, 5-2-2, and 10-4-4 lbs. of N, P_2O_5, and K_2O per 1000 sq. ft. per year. The 10 lb. N rate was applied in increments throughout the growing season so that no more than 2 lbs. were applied at any one time. All fertilizer materials were water soluble. The grass was cut to a 1.5 inch height twice each week and water was applied following each fertilizer treatment. These plots enabled us to evaluate turf performance and make several physiological measurements on grass managed under a combination of fertilizer formulations and rates.

Net photosynthetic carbon dioxide (CO_2) fixation of the turf was measured by determining the rate of CO_2 depletion from a glass bell jar mounted on an aluminum collar set in the sod. The results of an early June comparison of low and high fertility turf are presented in Fig. 1.

During the first three minutes, the rate of CO_2 consumption by heavily fertilized turf was almost 2x that of turf receiving the lowest fertility rate. This same trend was observed during most of the growing season. Of course these observations do not distinguish between differences in true photosynthic rate from variations of turf, thatch, or soil respiration. A more detailed analysis of CO_2 exchange by various turf components revealed that variation in net CO_2 fixation as measured here was most influenced by true photosynthesis. While respiratory rates did vary with fertility levels these differences were small compared to variations in photosynthetic CO_2 fixation. Net turf photosynthesis as influenced by fertilizer formulation is summarized in Table 1. While only the June observations showed statistically significant differences, a common

Fig. 1. Photosynthetic CO_2 utilization by high and low fertility Kentucky bluegrass turf. June 8, 1972.



Nutrient Balance

TABLE 1. Net CO_2 fixation rates of Kentucky bluegrass turf receiving various fertilizer formulations.

Fertilizer formulation	8 June 1973	18 July 1972	8 August 1973
	Date Measured		
		$mg\ CO_2/m^2/min$	
N	31.7 a*	22.3 a	24.3 a
N-P	35.0 ab	21.6 a	26.9 a
N-K	38.1 b	24.1 a	26.1 a
N-P-K	38.9 b	24.6 a	25.2 a

* Values in a column followed by the same letter are not significantly different at the 5% confidence level.

trend of greater CO_2 fixation by turf receiving a more balanced fertilizer is apparent. Even small increases in CO_2 fixation rate can generate substantial additional energy for the grass when extended over an entire growing season. These findings suggest that energy in the form of photosynthetic products is more available to turf which has received reasonable rates of a balanced fertilizer. Nitrogen fertilizer is more effective when combined with P and K.

A similar trend was observed in measurements of the amount of fixed CO_2 that translocated to the roots (Table 2). Here a 6-inch diameter circle of turf was covered by a bell jar into which CO_2 labeled with the radioactive isotope of carbon, ^{14}C, was introduced. The radioactive $^{14}CO_2$ was fixed photosynthetically and the ^{14}C-sugars produced were distributed within the plants just as ordinary sugars would. After exposing the turf to $^{14}CO_2$ for several minutes, the bell jar was removed and the grass left undisturbed until harvest, 1 to 3 days later. At harvest, a 4-inch plug of sod was removed from the exposed turf by means of a golf course cup cutter. The soil was carefully washed from the roots and the individual grass plants were divided into shoots and roots. These were dried and assayed for ^{14}C using a Geiger counter. The percentage of total recovered ^{14}C that was found in the roots served as a measure of the portion of photosynthetic energy that translocated to the roots. The results in Table 2 show that during most of the growing season, slightly more ^{14}C-photosynthate was found in the roots of turf receiving fertilizer containing P or K in addition to N. As with net photosynthetic rate, small increases in the percent of available energy transported to the roots can markedly increase root function during the summer months when cool season grasses are often subjected to heat and drought stress. This indicates that a better balanced fertilizer, by stimulating greater energy transfer to roots, should result in a healthier, more active root system. This should also result in turf better able to resist disease and mechanical injury.

Nitrogen fertilizer is more effective with P and K

Nutrient Balance

TABLE 2. Percent of the ^{14}C fixed by Kentucky bluegrass turf that was recovered from roots of grass receiving various fertilizer formulations.

Fertilizer formulation	Date exposed to $^{14}CO_2$ 13 April 1971	22 June 1971	7 July 1970	1 Sept 1970
		% of recovered ^{14}C		
N	12.0	12.8	9.5	6.5
N-P	9.6	11.7	8.6	9.5
N-K	13.0	17.3	9.6	8.3
N-P-K	14.2	11.0	10.1	8.0

TABLE 3. Injury ratings due to dethatching of variously fertilized Kentucky bluegrass turf.

Fertilizer formulation	Fertilizer rate lbs/1000 ft^2 2.5-1-1	5-2-2	10-4-4	Avg.
		Injury rating (10 = no injury)		
N	8.9 cd*	7.2 bc	6.9 b	7.7 rs
N-P	8.4 bcd	8.0 bcd	4.4 a	6.9 r
N-K	9.1 d	9.5 d	8.4 bcd	9.0 t
N-P-K	9.1 d	7.1 bc	7.8 bcd	8.0 st
Avg.	8.9 x	8.0 y	6.8 z	

* Values within the formulation by rate interaction and averages followed by the same letter are not significantly different at 5% confidence level.

Nutrient Balance

Differences in mechanical injury resistance was demonstrated dramatically during October 1973. An inexperienced worker was assigned to operate a dethatching machine over the plot area. The blades of the machine were set too deeply and a substantial amount of grass was dislodged from some plots. The injury caused by the thatch removal was rated and the results summarized in Table 3. Greater injury was observed on plots managed at the higher fertility levels and those plots receiving formulations lacking K were damaged more. The interaction between rates and formulations was also significant. An analysis of the data in Table 3 reveals that the increased injury in high fertility plots was not apparent when K was included in the fertilizer formulation. Differences in root growth probably account for the differential injury during thatch removal and this in turn could be related to greater photosynthetic rates and translocation to roots in grass receiving the more complete fertilizers.

Plots lacking K were damaged more

The most striking demonstration of differential turfgrass response to fertility regime occurred after 1972 when the plot area became infected with stripe smut. Caused by the fungus Ustilago striiformis, stripe smut is a systemic disease that is most damaging to Merion Kentucky bluegrass which is grown under intensive management (Hodge & Britton 1969). The disease caused a quality decline in those plots receiving the 10 lb. N rate and when P and K were included in the fertilizer, the disease was less severe (Hull et al. 1979). Tiller counts were taken in June 1973 and the percentages of diseased tillers were computed and are summarized in Table 4. Again the number of infected tillers increased sharply at the highest fertilizer rate and the N alone plots contained more smut than those also receiving P and K. The interaction between formulation and rate tells the real story in that the addition of either P or K reduced the incidence of infection and the inclusion of both P and K reduced infection further. The better bal-

TABLE 4. Stripe smut incidence on variously fertilized Merion Kentucky bluegrass turf in June 1973.

Fertilizer formulation	Fertilizer rate lbs/1000 ft^2 2.5-1-1	5-2-2	10-4-4	Avg.
	% smutted tillers			
N	7.6 de*	13.1 e	40.3 g	18.5 s
N-P	1.4 ab	4.8 bcd	29.6 f	9.0 rs
N-K	1.2 a	5.7 cd	25.5 f	8.4 rs
N-P-K	2.1 abc	1.7 ab	11.4 e	4.1 r
Avg.	2.6 x	5.7 y	25.9 z	

* Values within the formulation by rate interaction and averages followed by the same letter are not significantly different at the 5% confidence level.

Nutrient Balance

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anced fertilizer reduced disease levels at all application rates.

The application of fertilizer along with other good management practices stimulates tillering of both diseased and healthy plants. Good management will also prolong the life of infected plants. This might explain the greater percentage of infected tillers in plots receiving the higher N rates but not the reduction in diseased tillers in plots receiving high rates of P and K along with N. These results lead to the conclusion that Kentucky bluegrass turf receiving a balanced fertilizer even at high rates is more resistant to stripe smut infection.

The varied observations reported here all indicate that turfgrass nutrition is more demanding than fertilizer programs which concentrate on N might suggest. Nitrogen alone is not enough to produce quality turf. Even the descending analysis fertilizers (e.g. 20-10-5) probably do not provide optimum nutrition unless the soil has adequate P and K fertility. Turfgrasses, like other crop plants, require a balanced nutrient supply and the turf manager is best advised to consider this in his fertilization program.

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(This page was written as an aid to applicator companies. Its intended use is for customers who do not water their lawns and subsequently blame the company for a "lack of greenness." Although it is not written from a technical view, it does get to the heart of the matter by indicating the division of responsibility between company and customer. Permission is hereby granted to reprint either as is, or with any changes that the reader wishes to make.)

Dear Customer

Water makes grass green. Fertilizer, on the other hand, makes it thick and vigorous.

You may have been upset with us at one time or another because your grass wasn't as green as you would like it. If Mother Nature had given us three inches of rain the previous week, the situation would have been different— your grass would have been much greener.

Fertilizer programs are designed to provide your desirable turfgrass with enough nutrients to survive. Survival is, indeed, a choice word. You see, there are millions of weed seeds in your soil. These seeds will remain there until, for one reason or another, you have a thin spot in your lawn. When this occurs, undesirable grasses and broadleaf weeds will spring up. This competitive situation exists in all lawns and, because weeds have some natural advantages, the grass needs all the help the fertilizer can provide.

Over a period of time, virtually all lawns deteriorate. Most older lawns are a mixture of desirable and undesirable grasses. At some point, the homeowner will throw in the towel and replace his old lawn with a new one. Our job is to forestall this situation by applying the proper amount of fertilizer on your lawn. This fertilizer will give the desirable grasses a competitive edge.

Now you say that your neighbor puts extra nitrogen on his lawn and makes it darker green. This is quite possible. A few years ago we all wanted the darkest green lawns, but not anymore. Excess nitrogen can help make grass dark green but it can also promote too much top growth and contribute to the development of lawn diseases. These days, turf scientists are in general agreement that a dark green color is indicative of a potentially unhealthy lawn. For those who know, dark green is out of style.

Please don't hesitate to call us anytime to discuss your concerns.

Sincerely yours,

Your friendly lawn applicator

N, P, K and Kentucky Bluegrass Drought Recovery

by R. E. Schmidt

Dr. E. (Dick) Schmidt is a project leader of turf ecology and physiology, research and teaching at Virginia Tech. He received his B.S. and M.S. in Agronomy from The Pennsylvania State University and his Ph.D from Virginia Polytechnic Institute and State University. His research has been broad in scope, ranging from investigation of the influence of environment on carbohydrate reserves of both temperate and semi-tropical turf species to studying physical properties of soils used for turf. The results of his work on foliar nutrition of iron and time of nitrogen availability are widely accepted in the turf industry. Recently his efforts have been devoted to studying the fate of nitrates in soil water derived from different sources of fertilizers applied at different seasons. Dr. Schmidt is a member of the American Society of Agronomy, Sigma XI, Gama Sigma Delta, Phi Sigma, The International Turfgrass Society, American Sod Producers Association, and the Virginia Turfgrass Council.

Although Kentucky bluegrass, Poa pratensis L., a widely used temperate turfgrass, is regarded as intermediate in drought resistance, its turf quality is often reduced when soil moisture is limited during summer. There have been indications that turfgrass nutritional status is particularly important during periods of environmental stress. However, the turfgrass literature concerning nutrition effects on plant drought resistance is minimal.

Potassium fertility has been associated with the mechanics of leaf stomates, the openings through which gases are exchanged. Possibly, K is essential in the reopening of stomates that have been injured by drought, thus influencing photosynthesis. Heavy rates of N fertilization have been reported to increase water requirements and lower temperate grass resistance to drought. This may result when large amounts of N are available to temperate grasses under conditions that support rapid top growth. This causes rapid utilization of non-structural carbohydrates and subsequently inhibits root development and limits moisture uptake.

It has been shown, however, that bent-grass, Agrostis palustris Huds., produced more root weight when fertilized with N in the fall when folliar growth is slower than in the spring.

Heavy N fertilization may increase water requirement

The influence of P and K fertilizations in conjunction with N rates and timing of application on the recovery of Kentucky bluegrass from summer drought was observed a few years ago in turf experiments conducted at Virginia Tech. This study was conducted on a silt loam soil which had no previous record of fertilization and tested low in both P and K. Sufficient lime was incorporated into the soil to correct the pH to 6.5 and the area was seeded to common Kentucky bluegrass.

During the four years of the experiment, applications of 0, .66 or 1.32 lbs/1000 sq. ft. of P and 0, 1.21 or 2.42 lbs. of K/1000 sq. ft. were applied each May and September to maintain three separate levels of P and K. Lime was added periodically to maintain the soil pH at 6.0-6.5.

Kentucky Bluegrass

Also, N from ammonium nitrate was applied yearly at 3 or 6 lbs/1000 sq. ft. in strips across the P and K plots. Each rate of N was applied as one of three regimes. The spring regime had 2/3 of the total N applied between March and May; the summer regime had 2/3 of the total N applied between June and August; and the fall regime had 2/3 of the total N applied in September and October. Applications of 1/6 of the total yearly N were made in each of the other two other corresponding seasons to obtain the total yearly amount. From May 2nd to July 29th, 1966, only 2.5 inches of rainfall was recorded for the area. The turf became dormant so that no green color was evident. Between July 29th and August 15th, 6 inches of rain fell on the area.

Drought recovery for each fertilizer treatment was assessed on August 12th by measuring the fresh clipping yields which were then analyzed for total P and K content. The amount of available P and K were also determined from soil sampled to a 2 inch depth for each treatment in September.

Adequate P levels are imperative for rapid drought recovery

The yields following summer drought dormancy generally increased with the amount of soil (Table 1). However, the magnitude was influenced by rate and timing of N application. Although the first clipping yields obtained following the summer drought tended to increase with P, the increase was less for the spring N regime than for the fall or summer N regime. P fertilization was especially important to facilitate the Kentucky bluegrass drought recovery when high N fertility was applied. With high N, yields were significantly lower with low P than high P fertilization for all N regimes.

Davidson (1969) also reported perennial ryegrass yields following droughty conditions decreased with high N fertilization when P fertility was low. Indications are that adequate soil P levels are imperative for rapid Kentucky bluegrass recovery from drought,

Table 1. Clipping yields of Ky bluegrass turf after a summer drought as influenced by N and P fertilization.

* *

Season when 2/3 N applied	lbs. P/1000 Sq. Ft./Yr. 0	.66	1.32
	3 lbs. N/1000 Sq. Ft./Yr.		
	lbs./1000 Sq. Ft.		
Spring	2.3 a-c+	3.1 b-c	2.7 b
Summer	2.5 a-b	3.3 a-c	3.7 a-b
Fall	2.9 a	4.3 a	4.7 a
	6 lbs. N/1000 Sq. Ft./Yr.		
Spring	1.2 c	2.9 c	4.3 a
Summer	1.6 bc	3.3 a-c	3.9 a-b
Fall	1.6 bc	4.1 a-b	2.9 a

* *

+Value in each vertical column having a letter in common are not significantly different at the 0.05 level by Duncan multiple range test.

Kentucky Bluegrass

Table 2. Clipping yields of Ky bluegrass turf after a summer drought as influenced by K and P fertilization.

Yearly P lbs./1000 Sq. Ft.	lbs. K/1000 Sq. Ft.		
	0	1.2	2.42
		1bs./1000 Sq. Ft.	
0	1.8	2.1	2.1
.66	2.5	4.1	3.5
1.32	3.5	4.1	4.5
Average	2.7 B+	3.5 A	3.5 A

Average values for each K rate having a letter in common are not significantly different at the 0.05 level by Duncan's Multiple Range Test.

especially when liberally fertilized with N.

Although the yields interrelated with N and P fertilization, P strongly influenced recovery as indicated by a significant correlation between P soil or P tissue content with clipping yields.

K fertilization increased Kentucky bluegrass drought recovery irrespective of the N and P fertility status. However, the increase in yield associated with increased K fertilization was consistently enhanced with increased P fertilization (Table 2).

The tissue K content was found to increase with increased soil P content. However, the tissue P content did not increase with increased soil K content. This indicates that the yield recovery increase with P fertilization may be associated with the tissue K content. Possibly, a larger root system induced by P fertilization enabled the plant to obtain K from deeper in the soil profile.

It has been shown from previous studies that grass carbohydrate content, root development and turf quality improved when temperate grasses were fertilized heavily with nitrogen in late fall. The increased root development was attributed to enhancement of chlorophyll and buildup of photosynthate throughout the winter. From the results of this experiment, it may be shown that N readily available during the fall also provided for better Kentucky bluegrass growth following summer drought stress than if N was made readily available in the spring. Also, adequate P nutrition was essential for rapid recovery from summer drought, especially with high N fertilization. Possibly, P indirectly increases K uptake. Potassium seemed to be the paramount fertility nutrient for enhancing recovery of drought dormant Kentucky bluegrass.

**

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Davidson, R.L. 1969. Effects of soil nutrients and moisture on root/shoot ratios in Lolium perenne L. and Trifolium repens L. Ann. of Bot. 33:571-577.

Formolene Bulletin from Ashland

The Chemical Systems Division of Ashland Chemical Company has published a new bulletin on Ashland's Formolene brand of low-burn liquid fertilizers, according to John H. Detrick, manager of the Specialty Fertilizer Department. Formolene nitrogren fertilizer is a clear water solution of synthetic non-protein organic nitrogen, based on methylol-urea and urea. Turf-tested Formolene offers low-burn quick green-up, lasting color, nitrogen release in one season, and blends with other nutrients and pesticide chemicals.

Formolene is designed for lawn and turf grass applications by professional lawn care firms, Detrick said. It is ideally suited for use anytime during the lawn care season and it resists leaching and volatilization from the soil. Formolene requires no agitation and is nonabrasive and won't clog spray equipment. For copies of Ashland's Bulletin No. 1436, write Formolene, Ashland Chemical Company, Chemical Systems Division, Dept. LF, P. O. Box 2219, Columbus, Ohio 43216.

Political Action/ P.L.C.A.A.

A Political Action Committee has been established by the Professional Lawn Care Association of America to make the views of members known in areas impacting on the industry. Members are J. Martin Erbaugh, Chairman; Don Burton, and Larry Brandt. The action was taken at the recent meeting in Cleveland, Ohio of the Association's Board of Directors. For further information contact P.L.C.A.A., 435 N. Michigan Ave., Suite 1717, Chicago, IL 60611.

"Come now, Jackson! Let's not get petty."

Salt Index and Acidity

Foliar Burn and Soil Acidity Common Concern

by Stephen Brown

The tables shown below, which are available from Michigan State University Cooperative Extension Service, provide important information for lawn care professionals.

Table A shows the salt index and acidity of common fertilizers. This information is valuable because fertilizers are basically soluble salts which, when applied, increase the osmotic pressure of the soil solution. When the osmotic pressure of the soil solution gets high enough, water is pulled out of the grass plant. This, of course, results in "chemical burn". The solubility of the fertilizer, Table B, is related to the fertilizer's "burn potential". Those products which are very soluble are more likely to "burn" plants under adverse conditions. In fact, very soluble fertilizers such as potassium chloride and ammonium nitrate increase osmotic pressure so much that they will often prevent or delay germination of grass seeds they come in contact with.

The "salt index" states the effect of the fertilizer on the osmotic pressure of the soil solution in comparison to sodium nitrate. High salt indexes indicate that the product can more easily cause foliar burn under hot, dry conditions.

Fertilizers also affect soil pH. Most of the fertilizers used by lawn care companies will acidify the soil but a few do have the opposite effect (see Table A). The fundamental rules regarding soil pH are as follows:

A. Fertilizers which have nitrogen in the ammonia form or in other forms which change to nitrates (nitrificiation) will cause soil acidity.

B. Nitrogen fertilizers which have the nitrogen in nitrate form but in combination with bases such as sodium or calcium will decrease soil acidity.

C. The well-known potassium fertilizers, such as muriate and sulfate of potash, have no long-lasting effect on soil pH.

D. The superphosphates generally have no permanent effect on the acidity of the soil.

* *

TABLE A

SALT INDEX AND ACIDITY OF SELECTED FERTILIZERS

Fertilizer	Analysis	Lbs. Fertilizer /lb. nutrient	Salt[1] Index	Adjusted[2] Salt Index	Adjusted[3] Acidity
Sodium Nitrate	16-0-0	6.3	100	630	1.8 - B
Ammonium Nitrate	33-0-0	3.0	105	315	1.8 - A
Ammonium Sulfate	21-0-0	4.8	69	331	5.2 - A
Urea	46-0-0	2.2	75	165	1.7 - A
Diammonium Phosphate	21-53-0	4.8	34	163	3.5 - A
Calcium Nitrate	17-0-0	5.9	53	313	1.2 - B
Potassium Nitrate	13-0-44	7.7(N)	74	570	1.8 - B
Potassium Nitrate	13-0-44	2.3(K_2O)	74	170	1.8 - B
Potassium Sulfate	0-0-54	1.8	46	84	-
Potassium Chloride	0-0-60	1.7	116	194	-
Superphosphate	0.20-0	5.0	8	40	-
Superphosphate	0-46-0	2.2	10	22	-

1 From Rader, et al., Soil Science 55:201-218. 1943.

2 Salt index based on equal amounts of nutrient reacting in the soil.

3 Expressed as (A) pounds of calcium carbonate required to neutralize acidity from 1 pound of nitrogen or (B) basicity of 1 pound of nitrogen is equal to this amount of calcium carbonate.

TABLE B

SOLUBILITIES OF FERTILIZERS USED IN PREPARING LIQUID FERTILIZER SOLUTIONS

Fertilizer	Parts Soluble in 100 Parts Cold Water	lb/gal
Ammonium nitrate - NH_4NO_3	118	9.8
Ammonium sulfate - $(NH_4)_2SO_4$	71	5.9
Ammonium chloride - NH_4C1	30	2.5
Calcium nitrate - $Ca(NO_3)_2.4H_2O$	266	22.1
Diammonium phosphate - $(NH_4)_2HPO_4$	43	3.6
Monoammonium phosphate - $NH_4H_2PO_4$	23	1.9
Nitrate of soda - $NaNO_3$	73	6.0
Potassium chloride - KC_1	35	2.9
Potassium nitrate - KNO_3	13	1.1
Potassium sulfate - K_2SO_4	12	1.0
Urea - KH_2CONH_2	78	6.5
Single superphos - $Ca(H_2PO_4)_2.H_2O.CaSO_4$	2	0.2
Treble superphos - $Ca(H_2PO_4)_2.H_2O$	4	0.3
Sodium chloride - NaC1	36	3.0
Calcium chloride - $CaC1_2.6H_2O$	279	23.2
Borax - $Na_2B_4O_7.10\ H_2O$	1	0.1
Copper sulfate - $CuSo_4.5H_2O$	32	2.7
Ferrous sulfate - $FeSO_4.7H_2O$	16	1.3
Magnesium sulfate - $MgSO_4.7H_2O$	71	5.9
Sodium molybdate - $Na_2MoO_4.2H_2O$	56	4.6
Zinc sulfate - $ZnSO_4.7H_2O$	75	6.2
Manganese sulfate - $MnSO_4.4H_2O$	105	8.7

Fall, Not Spring Is Time to Act For a Beautiful Lawn Next Year

Mark this down on your calendar: Fall is the best time to prepare for a beautiful lawn next summer, according to the Professional Lawn Care Association of America. It's only an old wives' tale that spring is the most important time for lawn care. Most people think of spring as the time for planting and fertilizing and fall as the time for the lawn to rest. That's true for flower and vegetable gardens, but not for lawns.

September is the best month to reseed an existing lawn or start a new one with cool season grasses (bluegrasses and fescues). Unlike spring planting, which permits only a month or two of good growing conditions before hot, dry weather arrives, fall will allow several months of plant development weather before the stresses of summer. Lawn care professionals, like everyone else, appreciate the topside appearance of a lawn, but they know that the lawn's root system is the key to success. These lawn growth experts apply approximately two thirds of a lawn's annual nutritional requirements during fall and winter months, and only one third the rest of the year. Knowing not only how but when to maximize root developement is the single most important factor in establishing and maintaining high quality lawns.

Professionals also know that a lawn is living and active in cold weather months. Considerable research in the last 10 years has demonstrated clearly that root system development occurs readily in the winter. However, adequate amounts of nitrogen, phosphorous and potassium must be present in the soil for root systems to develop correctly. December, January and February are all good months to fertilize, with December and January being ideal.

Fall is an excellent time for weed control. In order for broadleaf weeds to be effectively controlled, they must be growing actively. Depending on where you live, October or November provide the best weed growing conditions. Therefore, these two months are the best for applying herbicide to eradicate broadleaf weeds. (It should be noted, however, that annual grassy weeds such as crabgrass are most easily controlled with pre-emergent herbicides applied in the spring.)

To sum it up, quality lawns need considerable attending during the time when many people think a lawn is dormant. Fall is the time for action. Many who want a beautiful lawn next year, without the work and anxiety that go with "do-it-yourself" lawn treatments, call in a professional lawn care firm. Their people are trained to do a professional job. No one has all the answers, but a professional lawn care firm concentrates time and effort in learning the most up-to-date techniques of developing a beautiful lawn– and then applying those techniques. Its personnel continually update their technical knowledge by attending educational seminars and workshops. Members of the Professional Lawn Care Association of America subscribe to the PLCAA's Code of Ethics and adhere to the highest standards of business practice. A "hot line" has been established to help inquirers find a local member of the Association. The "hot line" number: (312/644-0828), Professional Lawn Care Association of America, 435 North Michigan Avenue., Suite 1717, Chicago, IL 60611.

New Items

New Edition of Dow Insecticide Handling Book

Dow Chemical has released the new edition of "Dursban Insecticides . . . Suggested Handling Procedures For Professional Lawn Care."

Of special significance is the change in the wording of the Biomonitoring Section (page 1 & 2). Dow's recommendations for rechecking plasma cholinesterase levels and withdrawal from jobs are less stringent than before.

The new edition can be obtained by contacting Dow Chemical, Midland, Michigan, 48640. Refer to publication number 134-366-80 when ordering. Old copies of "Suggested Handling Procedures For Professional Lawn Care", bearing number 134-366-77, should be destroyed.

Research in Protective Clothing

Researchers at Michigan State University have determined that certain synthetic fabrics provide a better shield against pesticide exposure than does cotton. In this study, the traditional 100% cotton chambray work shirt allowed 25 times more pesticide through its fibers than the nonwoven and laminated synthetics.

Dr. Jacquelyn Orlando, of Michigan State University's Department of Human Environment and Design, said that the researchers hope to come up with specifications for clothing that would protect against pesticides and still be comfortable in hot weather.

An interesting finding of the Michigan State University research is that closely woven fabrics apparently enhance pesticide penetration. Current government recommendations regarding pesticide use suggest that applicators wear clothing made of such materials.

Boots Hercules Launches Nitroform Identity Program

Boots Hercules Agrochemicals Co. has launched a new identity program to make the buying public more aware of its long-lasting, nitrogen fertilizer Nitroform. Product Manager Bob Staib said, "This program is aimed especially at fertilizer formulators and blender-mixers serving the turf and horticultural market. It provides a way for them to reduce bag costs as well as promote Nitroform for BHA."

Boots Hercules will pay resellers a fertilizer bag allowance for using the Nitroform logo on the front of the bag. The allowance ranges from $.015 to $.06, depending on the net weight and percentage of nitrogen derived from Nitroform. Professional turf managers and nurserymen already are familiar with Nitroform and its non-burning, long-lasting characteristics. But this organic fertilizer is not as well known to the retail consumer of mixed fertilizers. Boots Hercules believes the retail consumer will be made more aware of Nitroform through the bag identity program. For more details write to C. Robert Staib, Boots Hercules Agrochemicals Co., Concord Plaza, 3411 Silverside Road, Box 7489, Wilmington, Del. 19803.

Fusarium Blight Added to Chipco 26019 Fungicide Label

An EPA registration for the control of Fusarium Blight on all common turf grasses has been granted for Chipco 26019 fungicide. Fusarium Blight has become a limiting factor in the widespread use of Kentucky bluegrass on home lawns and golf course fairways. Chipco 26019 now offers economical Fusarium Blight control and the continued use of Kentucky bluegrass as a desirable turf grass specie.

Application rate is 4 oz. of Chipco 26019 per 1000 square feet. Foliar application should begin when conditions first become favorable for disease development. Two additional applications should be made at 14 to 21 day intervals.

Chipco 26019 is a long residual contact fungicide. The technical ingredient, Iprodione, brings unique new chemistry to the United States. Chipco 26019 is also registered for the control of Dollar Spot (including Benomyl resistant strains), Brown Patch, Helminthosporium leaf spot and melting out,, Fusarium Patch (Pacific North West, only west of the Cascade Mountains) and Suppression of Gray and Pink snow mold. For more information, write to Rhone-Poulenc Chemical Company, Agrochemical Division, P.O. Box 125, Monmouth Junction, New Jersey 08852.

New Ideas

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Circle No. 4 on Reader Reply Card

Calendar of events:

September

Sept. 16-17
VPI and SU Turfgrass Research Field Days. Turfgrass Research Center, Blacksburg, Va. Contact: John R. Hall, III, Ext. Specialist, VPI & SU, 426 Smyth Hall, Blacksburg, Va. 24061.

Sept. 22-25
Northwest Turfgrass Annual Conference. Sunriver Lodge, Sunriver, Oregon. Contact: Dr. Roy Goss, Northwestern Turf Association, Western Washington Research and Extension Center, Puyallup, Washington, 98371.

Sept. 23
Turfgrass Field Tour and Equipment Show. Agronomy Farm, Oklahoma State University, Stillwater, Oklahoma. Contact: R. V. Sturgeon, Jr., 115 LSE, Oklahoma State University, Stillwater, Oklahoma, 74078.

Sept. 29
Midwest Turf Field Day. Purdue Agronomy Farm, Highway 52 West, West Lafayette, Ind. Contact: Dr. W. H. Daniel, Department of Agronomy, Purdue University, West Lafayette, Ind. 47907.

Sept. 30
Kansas State University Turf Conference. Kansas State University Union, Manhattan, Kansas. Contact: R. N. Carrow, Horticulture Department, Waters Hall, Kansas State University, Manhattan, Kansas, 66506.

October

Oct. 7-9
Kentucky Turfgrass Conference and Field Day. Eastern Kentucky University, Richmond, Kentucky. Contact: Kenneth B. Rue, Kentucky Turfgrass Council, 3110 Brownsboro Rd., Louisville, Kentucky, 40206.

Oct. 14-15
Symposium on Turfgrass Insects. Holiday Inn, Columbus, Ohio. Contact: Dr. B. G. Joyner, Plant Diagnostic Labs, Chemlawn Corp., 6969 Worthington-Galena Rd., Suite L, Worthington, Ohio, 43085.

Oct. 16-17
Southwest Turfgrass Association Conference. New Mexico State University, Las Cruces, New Mexico. Contact: Dr. Arden Baltensperger, Southwest Turfgrass Association, New Mexico State University, P.O. Box 3-Q, Las Cruces, New Mexico, 88003.

Oct. 19-22
28th Annual Conference and Show. University of Florida, Alachua County Fairgrounds and Hilton Hotel, Gainesville, Florida. Contact: Beth Eyman, Executive Secretary, Florida Turfgrass Association, 1520 Edgewater Drive, Suite E, Orlando, Fla., 32804.

Oct. 21-22
Green Industry Seminar. Community Arts Building, Michigan State Fairgrounds, Detroit, Michigan. Contact: Phil Goulding, Number1, Public Work's Drive, Pontiac, Michigan, 48054.

November

Nov. 5-7
Missouri Lawn and Turf Conference. University of Missouri, Columbia, Missouri. Contact: Dr. John Dunn, 1-43 Agriculture Building, Columbia, Missouri, 65211.

Nov. 9-12
Southern Turfgrass Conference. Birmingham Hyatt House, Birmingham, Alabama. Contact: Dr. Euel Coats, Southern Turfgrass Association, Drawer CP, Mississippi State University, 39762.

Nov. 10-13
National Lawn Care Business Conference. Sheration Twin Towers, Orlando, Florida. Contact: Erik Madisen, Box 1936, Appleton, Wisconsin, 54913.

Nov. 12-14
First Professional Lawn Care Association of America Convention. Commonwealth Convention Center, Louisville, Kentucky. Contact: Glenn Bostrom, PLCAA, Suite 1717, 435 N. Michigan Ave., Chicago, Illinois, 60611.

December

Dec. 1-4
National Fertilizer Solutions Association 26th Annual Convention and Chemical/Equipment Exhibition. Las Vegas, Nevada. Contact: Jerry Eisele, NFSA, 8823 N. Industrial Rd., Peoria, Illinois, 61615.

Dec. 8-11
New Jersey Turfgrass Expo '80. Cherry Hill Hyatt House, Cherry Hill, New Jersey. Contact: Dr. Henry Indyk, Soils and Crops Department, P.O. Box 231, Cook College, New Brunswick, N.J., 08903.

Part 1

What We DON'T Know About Fusarium Blight

by Patricia L. Sanders

Pat is a Research Associate in the Dept. of Plant Pathology at the Pennsylvania State University. She is responsible for the Research Program in Causes and Control of Turfgrass Diseases. Pat's excellent article, "The Microscope In Turfgrass Disease Diagnosis," appeared in the last issue of ALA.

Introduction

Fusarium blight is a severe mid-summer disease of Kentucky bluegrasses (Poa pratensis) on home lawns, golf course fairways, and other recreational areas. The use of the bluegrass cultivar Merion is widespread on such areas because of its resistance to other diseases, vigor of growth and recovery, and excellent play characteristics. Merion is particularly susceptible to Fusarium blight, and, because of its widespread use, loss of recreational and amenity turf to this disease can be severe in mid-summer. Fusarium blight is also an important concern of the sod production industry, and is causing increasing problems for these enterprises.

The disease was first described by Couch and Bedford who observed it on Merion Kentucky bluegrass in southeastern Pennsylvania. Since Couch and Bedford first described Fusarium blight, a great deal of research effort has been expended in attempts to understand and control this disease. Much of the research to date has led to contradictory conclusions, and control of Fusarium blight is still a difficult problem. In spite of intensive study, many aspects of Fusarium blight remain unexplained, including the role that Fusaria play in the development of the field symptoms. At this time, it is not possible to say with confidence what biotic and environmental factors may be involved in the etiology of Fusarium blight.

Disease Description

Descriptions of Fusarium blight in research reports are variable. Couch and Bedford reported that disease symptoms initially appeared in the field as scattered light green circular patches 2-6" in diameter. In later stages of disease development, the patches were 1-3' in diameter, light tan in color, and

Fusarium Blight

often contained center tufts of unaffected grass, producing a characteristic "frog-eye" appearance. In addition to "frog-eyes", affected areas also appeared as crescents, streaks, and circles. Couch postulated that both a leaf-blighting and a root rot phase may occur.

Another early worker reported that Fusarium blight infection centers were small (dollar spot size) at the outset and increased in size as the disease progressed. In his observations, "frog-eyes" were rare, and the disease in the field was confined primarily to the crown area. Other researchers described Fusarium blight of Kentucky bluegrass in California as being confined to the stem base and crown. "Frog-eyes" were not observed, and all plants within a blighted area were killed.

Still another worker, describing Fusarium blight in Pennsylvania, reported that the first symptoms noted were wilt and darkening of scattered areas of turf in the heat of the day. Within 48 hours, these areas took on a permanently-wilted, gray-green appearance, and then collapsed and bleached to a tan color. "Frog-eyes" were common, and the size of the affected area did not increase from the time the darkened patch was observed to the time the plants collapsed and turned tan. In severe infections, these patches coalesced to form large areas of blighted turf.

Many aspects of Fusarium blight remain unexplained...

Leaves, crowns, and roots of Merion Kentucky bluegrass from field infection centers of Fusarium blight have been examined histologically. Specimens from the "frog-eye", dead ring, and periphery of the dead ring exhibited varying degrees of vascular plugging in roots and crowns. A coarse, septate mycelium not typical of Fusarium in morphology and staining reaction was noted in the cortex of the crowns and in the cortex, perivascular fibers, endodermis, and xylem vessels of roots from the "frog-eye" and the dead ring. The fungus was most prevalent in specimens from the dead ring, and was never found in crowns from symptomless grass.

Casual Organisms

Couch and Bedford identified the Fusarium blight pathogens as Fusarium roseum f. sp. cerealis 'Culmorum' and Fusarium tricinctum f. sp. poae. Couch and Bedford concluded that F. roseum and F. tricinctum were the primary incitants of Fusarium blight, based on (1) consistency of isolation over a broad geographic area for several growing seasons, (2) the high degree of pathogenicity shown by these isolates on greenhouse-grown, seedling grass, and (3) the lack of pathogenicity or inconsistency of isolation of other microorganisms. Koch's postulates* have never been completed for Fusarium blight because attempts to produce the field symptoms on mature bluegrass with consistency by inoculation or environmental manipulation have been largely unsuccessful. Pathogenicity studies with Fusaria have usually been done by foliar inoculation of immature, greenhouse-grown grasses. Occasionally, greenhouse inoculation of grasses with Fusaria have been attempted by placement of the fungal propagules in the root zone. In all but one instance, greenhouse studies have not resulted in disease development that paralled development in the field. Without a reliable inoculation procedure, it is not possible to determine with certainty whether the Fusaria that are regularly isolated from bluegrass showing symptoms of Fusarium blight are indeed the causal pathogens. A study by Smiley, which attempted to determine the relationship between the numbers of Fusaria isolated from bluegrass areas with the incidence of Fusarium blight, revealed a negative correlation between these two parameters.

* *"Koch's Postulates" are a set of procedures which plant pathologists routinely go through to determine if a given pathogen is responsible for specific symptoms.*

Fusarium Blight

Host and Cultivar Susceptibility

Fusarium blight is not a serious problem on most cool season Kentucky bluegrasses in areas where summer stress conditions are not severe. It is the long, hot summers of the transition zone that the disease can assume epiphyotic proportions. Funk observed that very few of the best bluegrass cultivars have the qualities which allow production of an attractive, compact, dense, disease-free turf in severe summer environments. He therefore suggests that susceptibility to Fusarium blight is the result of an interaction between turfgrass cultivar and the environment under which the grass is grown. Studies on the relative susceptibility of bluegrass cultivars and blends to Fusarium blight produce results that vary somewhat from location to location.

Disease Development

Funk presented a list of factors which he believed might predispose turfgrass to Fusarium blight. These included high temperature, high humidity, recurring drought stress, reduced air circulation, excessive nitrogen, dense lush growth, thatch, close mowing, nematodes, and other diseases. Partyka stated that, since the Fusarium pathogens were present in most turf areas, infection and disease development were related to stress conditions, primarily drought and high temperature. He noted that anything restricting roots; such as compaction, shortage of nutrients, thatch development, nematodes, or insects; could predispose turf to drought stress and Fusarium blight development. He stated, further, that anything impeding water penetration; such as thatch, slope, or compacted soil; may induce water stress conditions.

Most research into the effect of temperature indicates that Fusarium blight incidence and severity increases as summer temperatures increase. Studies employing artificial inoculation of greenhouse-grown, seedling grass reveal that disease was most severe at temperatures between 81° and 91° F, and that severity increased as temperatures increased. In the field, the disease is active only during the warmest part of the summer,

Weather records indicate no apparent relationship

and Fulton stated that temperatures of 81° F or above are necessary in the 7 to 14 days prior to the development of Fusarium blight symptoms. However, a survey of weather records for 1966 and for 1973-1978 indicated that there was no apparent relationship between disease outbreaks and summer temperatures.

Most workers believe that drought stress is an important factor in the etiology of Fusarium blight. Cutwright and Harrison studied the effect of environmental factors on Fusarium infection of greenhouse-grown grass. Disease severity was greater under low irrigation at all inoculum levels. Couch and Bedford, however, found no significant differences in disease incidence between any of the Fusarium isolate/soil moisture regimes which they investigated in the greenhouse. In a field irrigation plot experiment, as the amount of irrigation increased from marginal to abundant, Fusarium blight decreased from 40% of the plot area affected to less than 1%.

Fusarium Blight

Troll observed that Fusarium blight was severe in Massachusetts during the moisture stress summer years of 1960-1966, but was less severe during the wet summer in 1967. In a Merion Bluegrass home lawn, no symptoms occurred in 1967, but occurred again in 1968, a year with a dry summer. Fulton observed that outbreaks of Fusarium blight in Pennsylvania are almost always preceded by a period of warm, wet weather followed by dry weather. A survey of weather data in New York indicated, however, that Fusarium blight outbreaks always occurred soon after a major rain.

Fusarium blight appears to be most prevalent on older, established bluegrass areas. Bean observed that a stand must be 3-years-old or more before the disease will occur, and Fulton reported that Fusarium blight in Pennsylvania was common on turf stands older than 5 years and was seldom seen on stands less than 2 years old. Cutwright and Harrison, however, observed Fusarium blight on stands of Merion that were less than 2 years old. Sanders and Cole have observed the disease on stands of blue-grass less than 1 year old.

There is a commonly held belief among those who work with turf that thatch accumulation predisposes turfgrass to Fusarium blight, but there is little research evidence to support this hypothesis. Several studies show no relationship between thatch depth and Fusarium blight severity. Turgeon observed no relationship between the thatching tendency of a

No relationship between thatch depth and Fusarium blight serverity

bluegrass cultivar and its susceptibility to Fusarium blight. On a sodded turf area, Fusarium blight was found to be most severe where the thatch layer was thinnest. Both Turgeon and

Fusarium Blight

Funk have observed coincident increase in thatch and Fusarium blight severity on field plots treated with tricalcium arsenate.

There appears to be a consistent relationship between severity of Fusarium blight and level of nitrogen fertilization. Endo and Colbaugh found that the disease was most severe in the field of plants receiving high levels of nitrogen and low amounts of water. Greenhouse studies show increased susceptibility to Fusarium infection when grass was grown under high levels of nitrogen.

Of the nutrient elements other than nitrogen, the role of calcium has been investigated. Couch and Bedford reported the results of a greenhouse investigation of the influence of normal and 0.1 normal levels of calcium on the susceptibility of foliage of seedling fescue, bluegrass, and bentgrass. In this study, disease incidence was significantly higher in plant groups grown under 0.1 X calcium. Another worker was unable to correlate disease severity in the field with low calcium levels. Applications of 1 kg hydrated lime/month/1000 $ft.^2$ were found to significantly increase incidence of Fusarium blight.

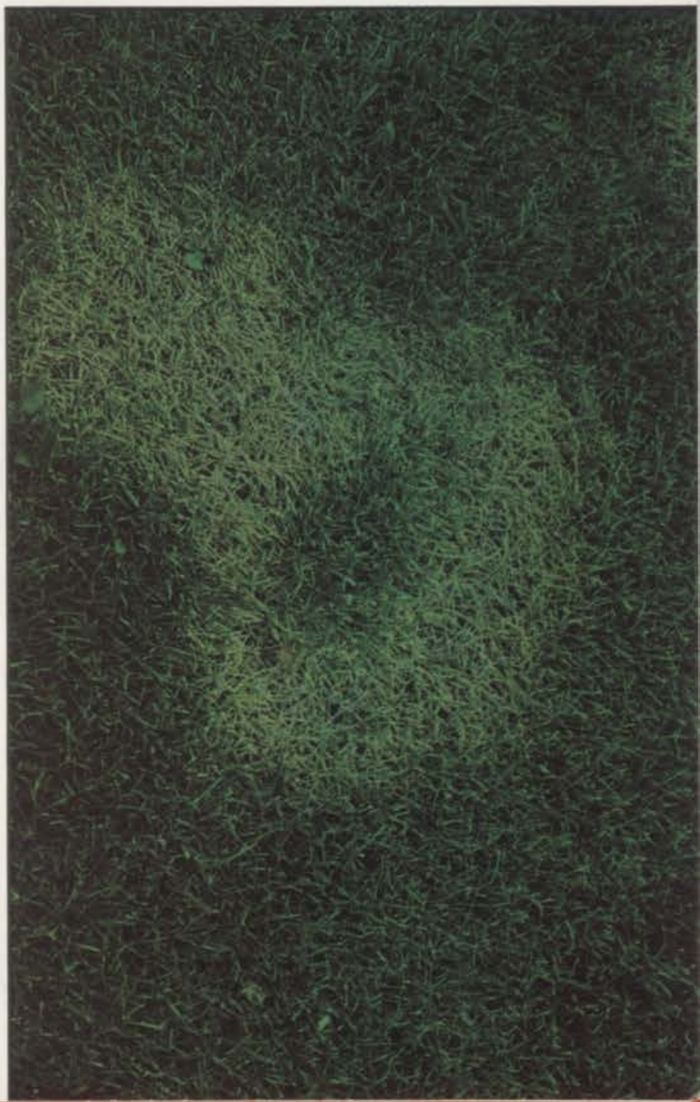
Partyka has raised the possibility that predisposing root organisms may be involved under certain conditions. He questioned whether organisms such as Pythium or Rhizoctonia may be present at low levels of activity early in the growing season and may be capable of weakening the turf so that Fusaria become established readily under favorable conditions.

Vargas and Laughlin investigated the role of Tylenchorhynchus dubuis, the stunt nematode, in Fusarium blight development on Merion Kentucky bluegrass. A survey by the authors indicated that Merion plants growing in blighted areas had poorly developed root systems, and were associated with high soil populations of T. dubius. Based on the results of greenhouse experiments, Vargas suggested that Fusarium blight may involve an interaction between F. roseum or F. tricinctum and T. dubius, or that T. dubius alone may be responsible. Couch and Bedford, however, were unable to associate high levels of parasitic nematodes with incidence of Fusarium blight. Cole observed that levels of parasitic nematodes were low on two Pennsylvania golf courses with histories of severe Fusarium blight. Both Vargas and Smiley have reported field control of Fusarium blight with nematicide application. Couch, however, obtained no disease suppression in field trials employing 4 nematicides.

There is a lack of consistency in results of research done at varying places and times to determine the effect of specific environmental stresses on the development of Fusarium blight. Recently, Smiley has suggested that, since response to stress at the cellular level is similar regardless of the stress, Fusarium blight may be triggered by stress in general, rather than a particular stress or stresses.

**

In the next issue of **ALA**, *Pat Sanders considers chemical control of Fusarium blight, looks at the role of moisture stress in Fusarium outbreaks, and discusses recent research on this strange and often devastating disease.*



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☐ Enclosed is a check for $_____ to pre-register ___ persons at $7.50 each per day

☐ Send data on local hotel/motel accommodations

☐ Oct. 21st– Turfgrass ☐ Oct. 22nd– Ornamental

Mail to: Phil Goulding, Number 1, Public Works Drive, Pontiac, MI 48054. Registration Deadline Octover 6, 1980

GREEN INDUSTRY SEMINAR
Booth Space Rental Form

Name: ____________________

Address: ____________________

____

☐ Please reserve booth space (10 x 20) $95

☐ Check enclosed ☐ invoice above address

☐ Send data on local hotel/motel accommodations

Mail to: Phil Goulding, Number 1, Public Works Drive, Pontiac, MI 48054. Registration Deadline October 6, 1980