JULY 1988

LAWN INSTITUTE

Harvests

Volume 35 Number 2

THE HARVEST MIX

In this issue of Harvests, the first part of an article on "The Lawnscape - An Ecological Wonder" appears. This section, "Grasses", will be followed by Part II - "Weeds"; Part III - "Disease and Insect Pests"; and Part IV - "The Living Soil". Together these articles present an overview of the ecology of turfgrasses and their environment.

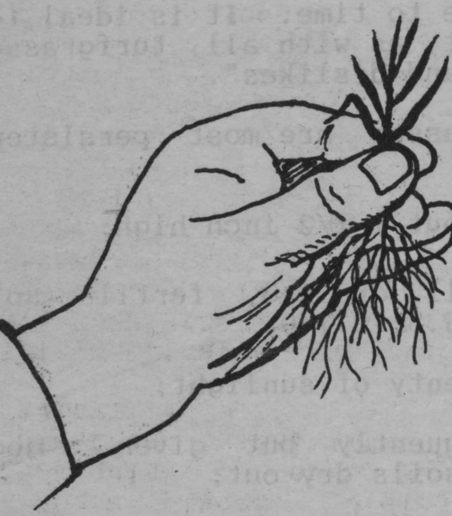
Reviews of eleven articles from journals serve as an update on research on Fertilization and Soil-Plant Relationships.

A synopsis of a forum, "Environmental and Regulatory Issues" presented at the 1988 Golf Course Superintendent's Association of America Convention is presented as "Turfgrass Management and Environmental Quality."

We hope you find this variety of subjects of interest and value.

THE LAWNSCAPE — AN ECOLOGICAL WONDER

Part I - Grasses



by

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The sounds of frogs and insect life in wetlands calls our attention to the ecology of these places. Biologically lawns are rather quiet, but even so, they are composed of plant and animal life that is teeming with activity.

A lawn cut at a two inch height is a very small "forest", but within this vegetative canopy are fascinating organisms that influence one another's life style and respond dramatically to changes in the environment.

Wetlands may be located some distance from us, but chances are good that you walk on a lawn most every day. Isn't it time to become more familiar with those organisms that contribute so much to the enjoyment of lawns and sports turf ?

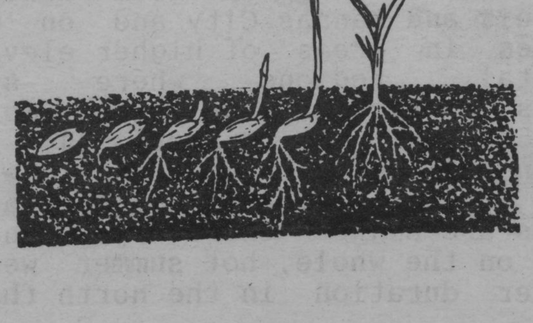
Six groups of plants and animals live on or within the soil to a six inch depth and within the two inch lawn foliar canopy. These are:

- turfgrasses;
- weedy plants;
- organisms that cause turfgrass diseases;
- insects that feed on turfgrasses;
- soil microorganisms - generally beneficial to turfgrass;
- and soil macroorganisms - generally not harmful to turfgrasses.

Then there is "bigfoot" - those of us that walk and play on the lawn. At times we do more harm to the turf by compacting the soil and scuffing the grasses than is caused by all the diseases and insects combined.

Have you noticed that sometimes lawn quality will vary from very good to very poor within a short distance ? Poorly maintained lawns may look awful. On the other hand, some of the best lawns I've seen were just left alone most of the time. Other lawns respond well to tender loving care, and yet, still others are over-maintained to the extent that they are less hardy and persistent and may even die. Why is this ?

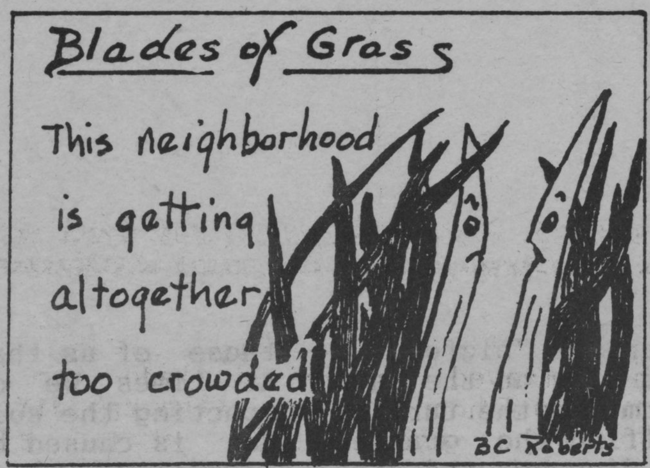
It's all related to the ecology of the lawn, that branch of science that is concerned with relations between plants and animals and their environment. Lawns and sports turf provide good examples of ecological principles and the understanding of these can help make you a lawn expert. This is not only good for improving environmental quality of your neighborhood, it is also likely that you can make your school grounds more attractive and your sports fields safer for play.



Grasses continued

Turfgrasses

Most lawns are made up of some thirty five million plants per acre. That's a little less than a million plants for each 1000 square feet. Even with all these plants under foot, most people don't know the kinds of grasses in their lawn. It's "lawngrass" and that's all there is to know. Not so, take a look at some of these differences.



Cool Season Lawns

Lawns in northern parts of the country contain one or more of the following grasses:

- Kentucky bluegrass [<u>Poa</u> <u>pratensis</u> L]
- perennial ryegrass [<u>Lolium</u> <u>perenne</u> L]
- fine fescue -
  * red fescue and Chewings fescue [<u>Festuca</u> <u>rubra</u> L]
  * hard fescue [<u>Festuca</u> <u>ovina</u> L]
- tall fescue [<u>Festuca</u> <u>arundinacea</u> Schreb]
- Colonial bentgrass [<u>Agrostis</u> <u>tenuis</u> Sibth].

This cool, humid region includes those states north of a line that extends from Washington DC to St Louis and Kansas City and on west. It also takes in areas of higher elevation and coastal regions where summer temperatures, particularly at night time, are cool [in 50s and 60s Fahrenheit]. This doesn't mean that northern locations are not hot during the summer. Often maximum temperatures are higher there than in the south, but on the whole, hot summer weather is of shorter duration in the north than in the south.

Kentucky Bluegrass

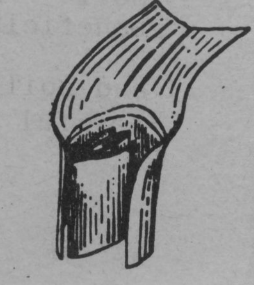
The basic lawngrass for northern parts of the country is Kentucky bluegrass. Once established, this grass spreads by underground stems called rhizomes. Thus, it is capable of filling in to heal areas of thin turf from time to time. It is ideal for sports fields. But, as with all turfgrasses it has its "likes and dislikes".

Kentucky bluegrasses are most persistent when:

- clipped at about 1 1/2 inch high;
- grown on a well drained, fertile soil with a pH of 6.5 to 7.0;
- exposed to plenty of sunlight;
- watered infrequently but given a good soaking when soils dry out;
- turf is groomed to prevent or remove thatch.

Kentucky bluegrasses are available as common types with a broad genetic base that helps make them adaptable to varying climatic conditions. They are also available as new, named cultivars. These are improved types with increased resistance to disease and insect injury and with increased vigor to help compete with lawn weeds. Some are even bred to tolerate more shade than others.

All Kentucky bluegrasses germinate slowly and make a relatively slow seedling start. Use of faster germinating companion grasses helps the establishment process.



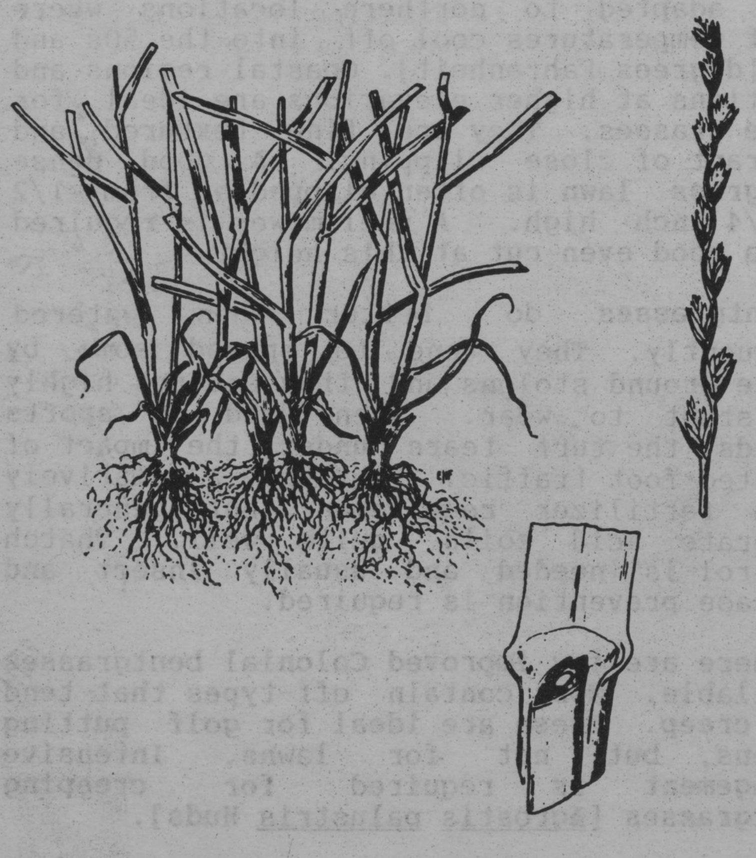
Perennial Ryegrass

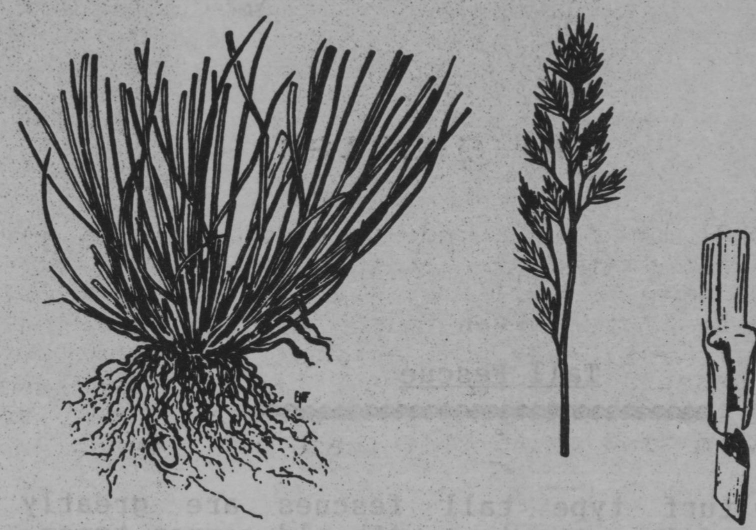
Perennial ryegrasses have been improved from the old common types. The new turf types have more narrow leaf blades that cut clean with a good sharp mower. They are darker green and more resistant to disease and insect injury. They have improved tolerance of hot weather when not pushed with too much fertilizer. They are quick to germinate and become established and thus are highly competitive as seedlings.

Perennial ryegrasses are not spreading types and therefore do not tend to form thatch. When turf thins out or suffers injury, perennial ryegrass is overseeded to get new plants started in these areas.

In general, these grasses are highly responsive to water and fertilizer. Although a soil pH of 6.5 to 7.0 is most desirable, they are known to perform well above and below this level. They may be clipped on lawns from 1 to 2 inches high and when overseeded on southern golf greens during the winter, are often mowed lower than 1/4 inch.

The new named cultivars of perennial ryegrass are such an improvement over old common types that all better lawnseed mixtures and blends now contain the new varieties.





Red Fescue, Chewings Fescue and Hard Fescue

Fine leaved fescues include the red, Chewings and hard types. Although different genetically, they have very similar characteristics in a turf stand. For example:

- they have very fine narrow leaves;
- they are as shade tolerant as any lawngrass;
- they have very low fertilizer requirements;
- they do best in a lawn when clipped at about 1 1/2 inches but can tolerate clipping heights of 1/4 inch when grown with bentgrasses in a golf putting green;
- they blend in well with other lawngrasses and thus are important components of seed mixtures;
- they perform well at pH ranges from 6.5 to 7.0 and will tolerate soils slightly more acid than this;
- although most fine fescues are not strong creeping types, they do spread some and often have a tendency to produce thatch;
- seed germinates rapidly and seedlings establish quickly; thus they aid in the development of turf that also contains slower starting grasses.

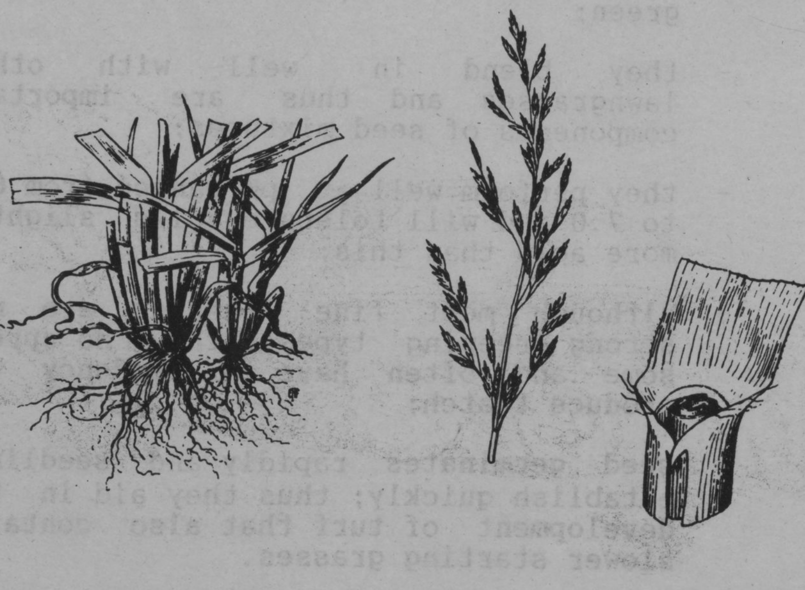
Grasses continued

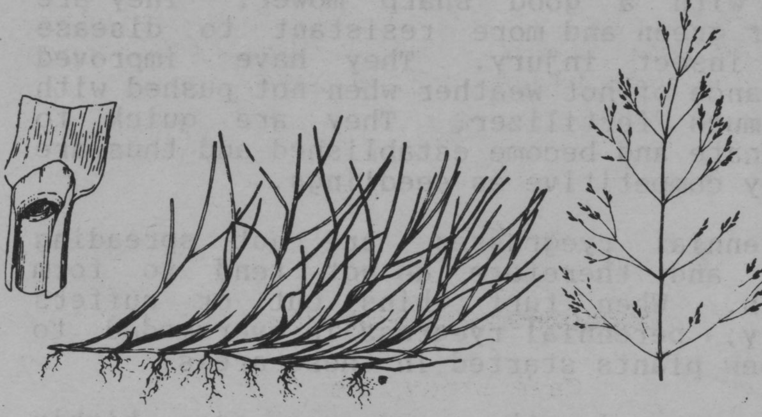
Tall Fescue

New turf type tall fescues are greatly improved in comparison with old common types, including Kentucky 31. They have finer leaf blades and create a tighter, more dense turf. Roots develop well and deep within the soil when clipping heights are from 2 to 3 inches. These grasses do not spread much and thus do not form thatch. They are "loners" and should not be mixed with other lawngrasses. When this is done they tend to clump up and become coarser in turf texture.

Turf type tall fescues have moderate fertilizer requirements and grow well on either side of a 6.5 to 7.0 pH range. They have high water requirements but because of extensive root development, they are able to extract water and nutrients from larger volumes of soil.

The new named cultivars have improved resistance to disease and insect injury and are tolerant of the higher summer temperatures characteristic of many locations throughout the north and upper south.





Colonial Bentgrass

Colonial bentgrasses are specialty grasses well adapted to northern locations where night temperatures cool off into the 50s and 60s [degrees Fahrenheit]. Coastal regions and locations at higher elevations are ideal for these grasses. They are fine textured and tolerant of close clipping. A good dense bentgrass lawn is often clipped at from 1/2 to 3/4 inch high. A reel mower is required for a good even cut at this height.

Bentgrasses do better when watered frequently. They tend to spread some by above ground stolons and thus are not highly resistant to wear. When used on sports fields, the turf tears under the impact of cleated foot traffic. They have a relatively high fertilizer requirement but generally tolerate acid soils quite well. Thatch control is needed and usually insect and disease prevention is required.

There are few improved Colonial bentgrasses available. Most contain off-types that tend to creep. These are ideal for golf putting greens, but not for lawns. Intensive management is required for creeping bentgrasses [Agrostis palustris Huds].

Grasses continued

Mixtures of Cool Season Grasses

When cool season grasses are blended; i.e., two or more cultivars of the same species are planted, growth requirements are sufficiently similar that major population shifts seldom take place. This is not so when two or more different species are included in a seed mixture. The following five case studies provide some insight into ecological changes that can take place in your lawn.

Case Study One

Kentucky Bluegrasses - Fine Fescues

One or more Kentucky bluegrasss cultivars are established with one or more fine fescues. Depending on soil and climatic conditions, major differences in population of grasses can develop. In this case, we start with equal populations of both species.

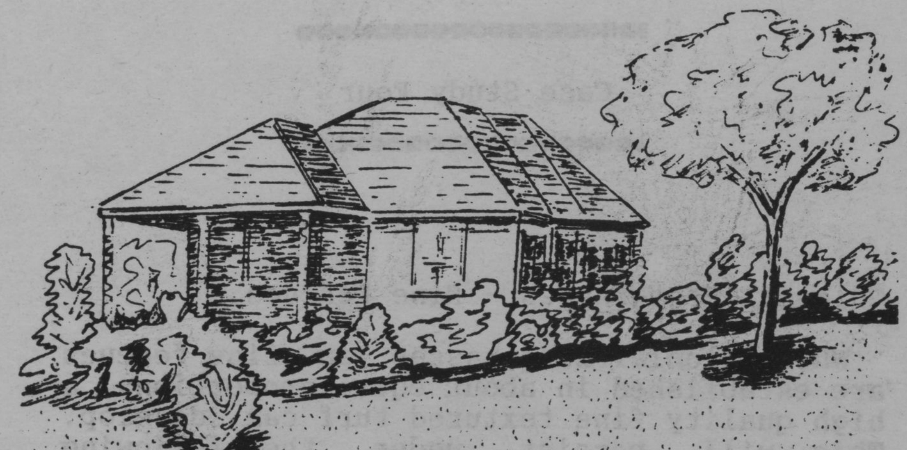
- In dense shade, few if any grasses will survive. Shade tolerant weeds will become dominant.
- In light shade the fine fescues will take over and may make up 100 percent of the turf cover. If Kentucky bluegrass cultivars Glade, Eclipse, Victa, Bristol, Bensun and Nugget are included in the mixture, these grasses will share dominance with the fine fescues.
- In sunny locations, the bluegrasses will be dominant and may occupy 100 percent of the turf cover.
- Under well fertilized lawn conditions, the Kentucky bluegrasses will crowd out the fine fescues as long as light is not limiting.
- When the lawn is not well fertilized, the fine fescues will take over and become dominant, even where there is no shade.
- Levels of fertilizer and/or water that are applied in excess of normal needs will increase pest susceptibility and neither bluegrass nor fescue will persist.

Case Study Two

Kentucky Bluegrasses - Fine Fescues - Perennial Ryegrasses

In addition to the Kentucky bluegrasses and fine fescues included in Case Study One, we add one or more perennial ryegrasses. At this point, the proportion of bluegrass to fescue to ryegrass makes a difference.

- Where from 10 to 20 percent of the grass stand is perennial ryegrass and the remainder is about equally divided between bluegrass and fescue, a good stable mixture will result under moderate maintenance practices in sunny locations.
- Where from 20 to 50 percent of the grass stand is perennial ryegrass, the bluegrass and fescue will have difficulty competing under moderate maintenance practices in sunny locations.
- As shade increases, the bluegrass and ryegrass will give way to the fescue, which will become dominant.



Grasses continued

Case Study Three

Kentucky Bluegrasses - Colonial Bentgrasses

This turf is established with about equal numbers of Kentucky bluegrass and colonial bentgrass plants.

- As shade develops, neither species will survive unless Kentucky bluegrass cultivars Glade, Eclipse, Victa, Bristol Bensun and Nugget are included.
- Infrequent deep watering and clipping heights 1 1/2 to 2 inches will favor the Kentucky bluegrass and it will become more dominant.
- Frequent light watering and clipping heights of 1/2 to 3/4 inch will favor the Colonial bentgrass and it will become more dominant.
- Under acid soil conditions [pH 5.0 to 6.0] the Colonial bentgrass will be more aggressive and the Kentucky bluegrass less dominant.
- Under generally favorable maintenance practices for both grasses, the Colonial bentgrass in time will colonize to form unsightly patches. In this condition, it becomes an unsightly weed.

Case Study Four

Colonial Bentgrasses - Fine Fescues

When Colonial bentgrasses and fine fescues are established in about equal proportions, a high quality fine textured turf can develop. This will persist under the following conditions:

- there is adequate sunlight for the bentgrass; in shaded locations, the fescue will take over;
- there is adequate moisture for the bentgrass without having too much water for the fescue;
- there is adequate fertilizer for the bentgrass without having too much for the fescue.

Since the bentgrass and the fescue have similar soil pH and clipping requirements, they co-exist without the fescue ever posing as a threat. Thus, the bentgrass stays dominant with fescue well dispersed. This eliminates the unsightly clumping or colonization often observed with bentgrass and bluegrass.

Case Study Five

Turf Type Tall Fescues - Kentucky Bluegrasses

Turf type tall fescues seeded by themselves at about 8 pounds per 1000 square feet produce a nice uniform monostand. When Kentucky bluegrasses or other lawngrasses are mixed with tall fescues, a competition between the species develops. As long as there is not more than 10 percent of a relatively non-aggressive bluegrass, such as one of the common types, the mixture is likely to persist. More bluegrass than this, or use of one or more of the new more vigorous types, and the potential for colonization develops. Patches of bluegrasss interspersed with clumps of coarser leaved tall fescue produce an unsightly lawn. In this case, the bluegrass spreads and becomes dominant and the tall fescue becomes a weed.

Grasses continued

Warm Season Lawns

Southern lawns contain one of the following grasses:

- bermudagrass [Cynodon spp];
- zoysiagrass [Zoysia japonica Steud; Zoysia matrella (L) Merr];
- centipedegrass [Eremochloa ophiuroides (Munro) Hack];
- St Augustinegrass [Stenataphrum secundatum (Walt) Kuntze];
- bahiagrass [Paspalum notatum Flugge].

These are generally used as monocultures rather than in mixed stands. Thus, competition takes place among different plants of the same species, but there is little opportunity for different species to compete with one another.

There are many similarities in growth characteristics and requirements among these grasses. They are all well adapted to the southern climate of hot summers and relatively mild winters. They are dormant and mostly brown during winter months. Green foliage develops as spring warmth returns and vigorous growth is maintained until cool fall weather returns. Because of this, late spring planting is required to provide a long enough growth season to get them established. In addition, since they are dormant for many weeks during fall, winter and early spring, winter grasses are overseeded to provide growing turf for lawns and sports fields during this period.

There is much variation in the growth season from lower Florida and along the Gulf Coast on up into the upper south. Minimum temperatures during the winter are much lower throughout the upper south. This may cause winter kill of lawngrasses in these regions. Turfgrass growth is complicated further throughout the southwest by lack of rainfall. When this limiting factor cannot be supplemented with irrigation other dryland grasses such as buffalograss [Buchloe dactyloides (Nutt) Engelm] are used for lawns.

There are major differences in growth characteristics and requirements among the warm season grasses. These include the following.

Bermudagrass

Common bermudagrasses are available as seed, but the new improved types are all sterile hybrids and must be propagated vegetatively from sprigs. They form the basic grass for warm season lawns and sports turf.

Bermudagrasses spread rapidly to form a dense turf. They may be clipped close and form a nice uniform lawn at heights of one inch or less. They respond to fertilization and irrigation but actually have rather low water requirements. At higher mowing heights, they become good, low maintenance grasses.

Zoysiagrass

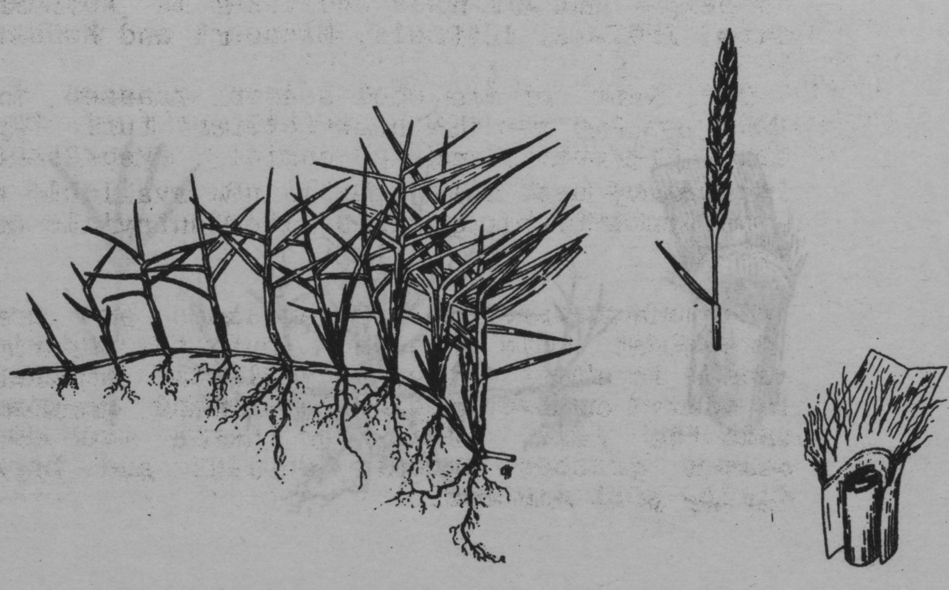
As with bermudagrass, the common types of zoysia are available from seed but the improved types are propagated vegetatively. Unlike bermudagrass, there is not much seed available. Most seed comes from Korea, Japan and the Philippines and is expensive - some 5 times the cost of other lawngrass seed.

Unlike bermudagrass, zoysia is very slow to establish. Up to 4 years may be required to develop a zoysia lawn from sprigs or plugs. Once established, it has low maintenance requirements and even a slow growth rate that reduces the frequency of mowing.

Zoysiagrass is more winter hardy than bermudagrass and has found some acceptance throughout the upper south where bermudagrasses winter kill. It is good at conserving water and once established, fertilizer requirements are low.

Turf type tall fescues seeded with zoysia make a stable turf combination. The zoysia, because of its slow growth rate, does not compete with the fescue to cause colonization or clumping. Once established, the zoysia is dominant and green during the summer and the tall fescue is dominant and green during fall, winter and early spring when the zoysia is dormant and brown. This combination is about as close to year-round green turf as has been possible in the upper south.

Zoysiagrass is used some on golf course fairways but it generally heals too slowly for use on other sports fields.



Centipedegrass

Both seeded and vegetatively propagated types of centipedegrass are available. It produces a medium textured lawn at clipping heights of 1 1/2 to 2 inches. It is a low maintenance grass and is easily weakened from use of too much fertilizer.

Although used on some low maintenance playgrounds, centipedegrass is not vigorous enough for most sports fields.

St Augustinegrass

St Augustinegrass is only available for vegetative propagation. It is coarse textured and most shade tolerant of the warm season grasses. Maintenance requirements for fertilizer and water are relatively high but it makes an excellent dense lawn. A major sod production industry exists in those areas through Florida and along the Gulf Coast where St Augustinegrass does particularly well.

Its spongy nature limits its use for sports turf. And, most selections of St Augustinegrass are prone to insect injury.

Grasses continued

Bahiagrass

Available as seed, bahiagrass is used for lawns and play fields through the deep south. It produces an open type of growth that never really makes a good sod. It is best adapted to regions along the Gulf coast.

Wintergrass

As warm season grasses become dormant with the onset of cooler fall and winter temperatures, they turn from green to brown. Zoysiagrasses become a more golden brown. The further south, the later this dormancy is initiated. Even in Florida, the practice of overseeding dormant bermudagrass with wintergrass blends and mixtures is common. Bluegrasses, fine fescues, ryegrasses and bentgrasses are used for this purpose. Although these are all perennial grasses, they are used as annuals. Seed is planted in late fall in a specially prepared and scalped turf. It is encouraged to germinate and establish quickly so as to provide green color and a suitable cover for sports activities from golf to football.

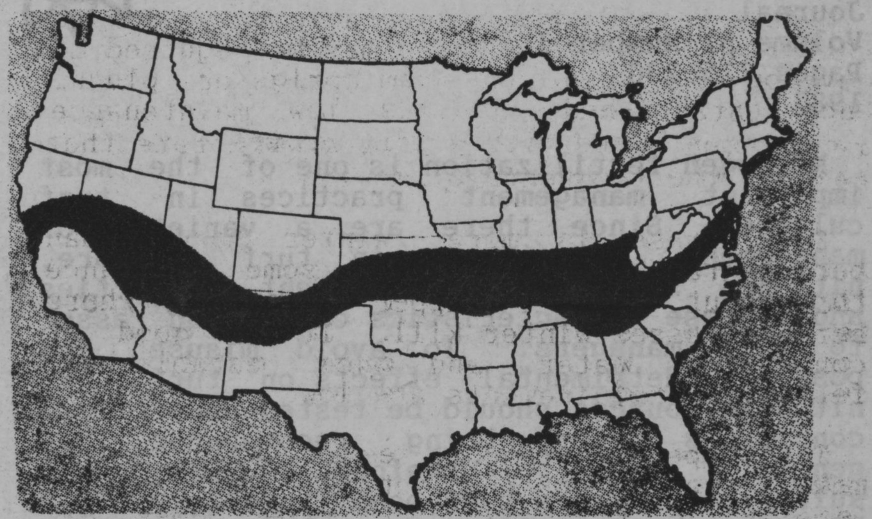
Wintergrasses also compete with weeds and help keep them out of what otherwise becomes an unsightly patch of green weeds and dormant brown turf. Where wintergrasses are not used herbicidal treatments are necessary at increased application frequency.

Buffalograss

One other grass is used where summer temperatures run high and humidity is low. Buffalograss has a place in parts of the central west and southwest. This grass will not compete favorably with bluegrass where sufficient rainfall or irrigation moisture is available. It will make a satisfactory turf in areas of limited rainfall. Available as seed, buffalograss is often used with other range grasses that tolerate summer heat and drought.

Kikuyugrass

Kikuyugrass [Pennisetum clandestinum Hochst] is considered more of a weed than a turfgrass. It was introduced into southern California and has spread to the degree that it is maintained as a turf in some locations. Control measures have not been very effective. Thus, since it's there, the best possible lawn and sports turf is being developed. The resulting turf is open in nature and coarse textured.



Lawns In The Transition Zone

Between the upper south and lower north there is a climatic region that is not well suited to either warm or cool season grasses. It's generally too hot in the summer for cool season grasses and too cold in the winter for warm season grasses. This so called transition zone follows the lower elevations of Virginia and North Carolina west through West Virginia, Kentucky, Tennessee and Arkansas and takes in southern Ohio, Indiana, Illinois, Missouri and Kansas.

The best of the cool season grasses for this region are the heat tolerant turf type tall fescues and perennial ryegrasses. Increasing heat tolerance is now available in some Kentucky bluegrasses like Huntsville and Wabash.

Bermudagrasses and zoysiagrasses are used throughout this region, but the growing season is short and usually little emphasis is placed on overseeding to extend greenery into the fall. This far north even cool season grasses become dormant and brown during most winters.

Fertilization and Soil - Plant Relationships

RESPONSE OF TURFGRASS TO VARIOUS NITROGEN SOURCES

P J Landschoot and D V Waddington
Soil Science Society of America Journal
Volume 51 Number 1
Pages 225-230
1987

Nitrogen fertilization is one of the most important management practices in turf culture. Since there are a variety of management situations in turf culture, nitrogen sources with different properties and release characteristics can be an asset to turf managers. To avoid misuse and possible detrimental effects on turf, new nitrogen sources should be tested under field conditions before being recommended for general use. Ureaform, IBDU and sulfur-coated urea have been thoroughly field tested. Identification of release characteristics of various urea-formaldehyde reaction products, oxamide, fine sulfur-coated urea made with curtain granulated urea, sulfur-coated urea with coarse particle sizes, products containing combinations of nitrogen sources, composted sewage sludge, IBDU, soluble sources and Milorganite are subject to continuing study.

Research at Pennsylvania State University has been conducted to determine the turf response to several nitrogen sources on Merion bluegrass turf using the criteria of turf color, yield and nitrogen uptake. Results are outlined as follows.

- The greatest initial growth and color responses following fertilization occurred with soluble nitrogen sources and combinations of soluble and slow-release nitrogen sources.

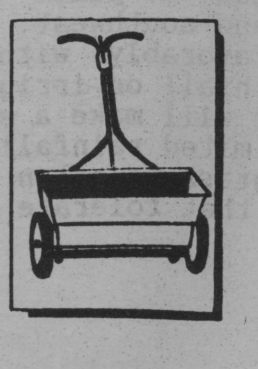
- Slowest to produce a response following application were IBDU and oxamide. Soluble sources can be used in conjunction with these sources to hasten response.

- Residual responses were most apparent in the spring prior to fertilization and in late summer. Residual effects were greatest with IBDU, oxamide and TVA sulfur-coated urea -6f. Use of such materials in the fall would eliminate the need for early spring fertilization.

- With urea-formaldehyde reaction products, response decreased as the amount of nitrogen as water insoluble nitrogen increased. The more soluble products were more efficient nitrogen sources for two years; however, residual response from the less-soluble products was apparent in late summer.

- Fine oxamide [less than 0.25 millimeter] provided a quicker response but less residual response than coarse oxamide [1 to 3 millimeters] which gave responses similar to those obtained with IBDU [0.7 to 2.5 millimeters]. Particle size would be an important consideration when selecting either of these products for use.

- Response differences with sulfur-coated urea were associated with the dissolution rate and particle size. Products with higher dissolution rates gave quicker responses and less spring residual than products with lower dissolution rates. Greater yields and nitrogen uptake with sulfur-coated urea-15f than with sulfur-coated urea-25c indicated faster release with fine sulfur-coated urea under field conditions.



- Sludge compost was ineffective as a turfgrass fertilizer. When the compost was amended with urea to bring the nitrogen content up to 6 percent, response was similar to that obtained with soluble sources.

- Milorganite gave one of the lower responses during the study; however, response was relatively uniform and a residual effect from this natural organic source was noted in late summer.

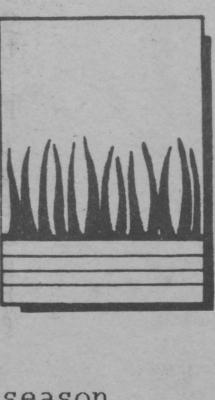
- Turf color and yield were correlated with nitrogen uptake; thus, darker color and greater yields reflected a greater efficiency of applied nitrogen.

- In practice, uniformity of response throughout the growing season must also be considered. Quick-acting nitrogen sources need to be applied more frequently than slow-release sources to obtain this uniformity. In lawn care situations where quick response and repeated visits are desired, soluble sources alone or in combination with slow-release sources are appropriate. If sulfur coated urea is used, a high dissolution rate would be appropriate.

- In situations where less frequent fertilization is desired, longer-lasting sources should be selected.

- Burn potential, cost, and availability are other factors affecting nitrogen source selection.

GROWTH OF ZOYSIAGRASS FROM VEGETATIVE PLUGS IN RESPONSE TO FERTILIZERS



J D Fry and P H Dernoeden
Journal American Society of Horticultural Science
Volume 112 Number 1
Pages 286-289
1987

Decline in quality of cool-season turfgrasses as a result of environmental stresses and disease in the transition zone has increased the use of warm-season turfgrasses, particularly zoysiagrass. The transition zone is a region of turfgrass adaptation where neither warm or cool-season grasses are well-adopted. Meyer zoysiagrass is a desirable cultivar because of its excellent high and low temperature tolerance and drought and disease resistance. The major factor limiting more-extensive use of zoysiagrass is the substantial period of time required for establishment. In the transition zone, 2 or more years usually are required to achieve complete coverage from vegetative plugs. Although fertility generally is believed to be a prime factor in hastening zoysiagrass establishment, little research has been conducted to determine the influence of fertilizers on establishment rate.

Research at The University of Maryland has been conducted to determine the influence of nitrogen source and rate and the influence of nitrogen, phosphorus and potassium interactions on the establishment rate of Meyer zoysiagrass and to evaluate the frequency of application of water-soluble nitrogen on the establishment rate of Meyer and Belair zoysiagrass. Results are noted as follows.

- Five months after planting, none of the slow-release nitrogen sources or nitrogen, phosphorus, potassium combinations had enhanced coverage of zoysiagrass plugs.

- No additional fertilizer was applied the second year of the test. By the end of the second growing season, the actual increases in zoysiagrass coverage provided by fertilizer were no greater than 5 percent more than the unfertilized zoysia.

- Preplant incorporation of moderate rates of slow release nitrogen - 175 pounds per acre per year [196 kilograms per hectare per year] combined with phosphorus and potassium may be beneficial in poorly nourished soils.

- In the second year of establishment, applications of a soluble nitrogen fertilizer - nitrogen at 1 to 2 pounds per 1000 square feet per month [49-98 kilograms per hectare per month] can be applied to accelerate growth of Meyer and Belair zoysiagrass.

- It should be noted that establishment studies can be quite variable due to differing irrigation frequencies as well as differing soil and environmental conditions within a state or region.

EVALUATION OF LIQUID-APPLIED NITROGEN FERTILIZERS ON KENTUCKY BLUEGRASS TURF

B G Spangenberg, T W Fermanian and D J Wehner
Agronomy Journal
Volume 78 Number 6
Pages 1002-1006
1986

Turf fertilizers can be classified as either quick-release [water soluble nitrogen sources] or slow-release [sources with a dissolution rate much less than that obtained for a completely water soluble source]. Quick-release fertilizers provide a rapid initial turf response but may over-stimulate the grass or cause foliar injury and have a short residual.

Lawn care professionals make 3 to 5 applications of fertilizer to a home lawn during the year. Because customer satisfaction depends on a noticable turfgrass response to the applied treatment, the lawn care companies generally use quick-release nitrogen sources. Because of its low cost, high water solubility, and relatively low salt index compared to other soluble nitrogen sources, urea is the predominant nitrogen source used by this industry. Urea is applied either as a spary with water or in a granular form. During certain times of the year turf response to urea can dissipate before the next application of fertilizer can be made. Also, there is the potential for foliar fertilizer burn because of the wide range of environmental conditions encountered in scheduling multiple applications to a large customer base.

Alternative nitrogen sources have been developed for use by lawn care companies that apply fertilizer as a spray solution in attempts to overcome the drawbacks of urea. These include a suspension nitrogen source [FLUF] and a solution nitrogen source [Formolene] with lower salt indexes than urea. Both materials are manufactured by reacting urea and formaldehyde, but reaction conditions are such that only a small amount [3.6 percent] of water insoluble nitrogen is contained in FLUF and none in Formolene. Nitroform [38-0-0], the first ureaform fertilizer developed for turfgrass, contains 27 percent water insoluble nitrogen.

There have been reports on the efficacy of nitrification inhibitors - nitrapyrin, terrazole and dicyandiamide. These may be of value in reducing losses of nitrogen from ammonia volatilization.

Research at the University of Illinois has been conducted to evaluate the response of Kentucky bluegrass to applications of solution and suspension nitrogen sources, alone or in combination with urea, by comparisons to responses from applications of standard fertilizers and to compare the burn potential of these new fertilizers to that of spray-applied urea, urea-ammonium nitrate and a liquid 12-1.8-3.3 fertilizer. A secondary objective of this research was to compare turf response to applications of ammonium sulfate and urea with or without a portion of the nitrogen coming from dicyandiamide. Results have been reported as follows on Kentucky bluegrass turf.

- Turf response to Formolene [solution nitrogen source] paralleled that due to spray-applied urea.
- Turf treated with spray-applied urea received higher color ratings than did that treated with Nitroform or FLUF [suspension nitrogen source] during the early growing season, but this trend was reversed by late summer.
- Turf fertilized with FLUF resembled turf fertilized with Nitroform, but was inferior to turf fertilized with sulfur-coated urea.
- There was no benefit from the inclusion of dicyandiamide with either ammonium sulfate or urea.
- Soil pH after 2 years ranged from 5.3 to 6.4 and was lowest with ammonium sulfate treatment.
- Thatch depth ranged from 1/3 to 4/5 inch [7.0 to 19.3 millimeters] and was greatest with ammonium sulfate treatment.
- Formolene and FLUF caused less foliar injury than did spray-applied urea, urea-ammonium nitrate, or the 12-1.8-3.3 fertilizer. Results from the two experiments indicated that the major advantage of using Formolene or FLUF was the reduced potential for foliar fertilizer burn.

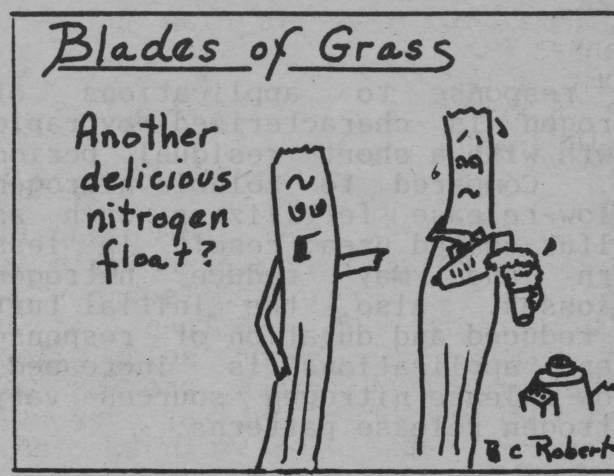
FIELD DISSOLUTION OF SULFUR-COATED UREAS IN TURFGRASS

N W Hummell, Jr and D V Waddington
HortScience
Volume 21 Number 5
Pages 1155-1156
1986

Slow-release fertilizers are a valuable means of maintaining turfgrass quality. Sulfur-coated urea is a slow-release fertilizer that has become very popular in the turfgrass industry. Sulfur-coated urea is less expensive than other slow-release fertilizers and is an effective nitrogen source for turfgrass fertilization.

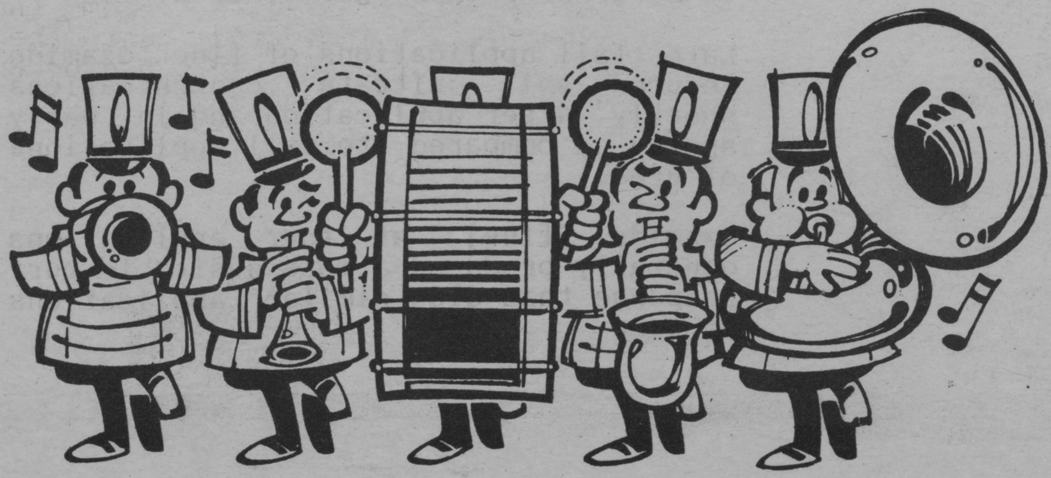
The dissolution rate of sulfur-coated urea is strongly influenced by the manufacturing process. Different dissolution rates may be obtained by varying the coating weight [thickness] or method of deposit. Release rates of sulfur-coated urea are characterized by a 7-day dissolution rate, which indicates the percentage of urea that goes into solution when the product is immersed in water at 100 degrees Fahrenheit [38 degrees Centigrade] for 7 days. In field studies, turfgrass response to sulfur-coated urea applications varied with coating thickness and method; therefore, the 7-day dissolution rates were not always reliable in predicting response in the field.

Sulfur-coated urea is available commercially to turfgrass managers in different particle sizes. As particle size decreases, the surface area per unit weight of fertilizer coated increases. If sulfur is applied at the same rate per weight of fertilizer, decreasing particle size decreases coating thickness. Materials with thin coatings usually have fast dissolution rates.



Research has been conducted at Pennsylvania State University on a 3 year old stand of Pennfine perennial ryegrass to compare field dissolution of 10 sulfur-coated urea materials with different dissolution rates and particle sizes. Results of note follow.

- In comparisons of fine and coarse sulfur-coated urea with similar laboratory dissolution rates, the fine materials dissolved faster than the coarse materials.
- The 7-day dissolution rate is a good indicator of field dissolution when sulfur-coated urea sources of similar manufacturing methods are compared.
- When the range of sources made by different technologies are compared, the 7-day dissolution rate is of limited value for predicting field dissolution.



THRESHING THE JOURNALS continued

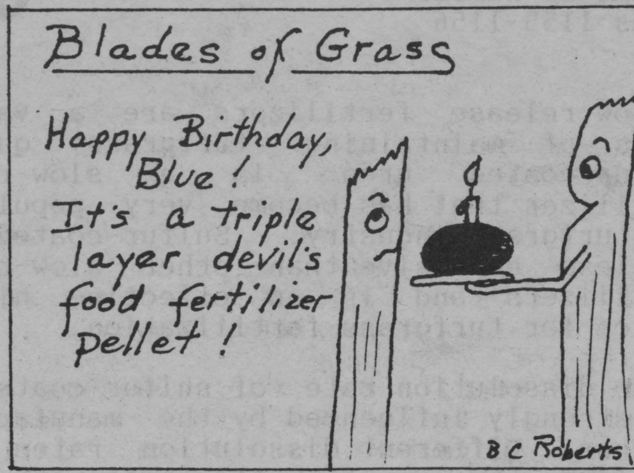
EVALUATION OF OXAMIDE AS A SLOW-RELEASE NITROGEN SOURCE ON KENTUCKY BLUEGRASS

D K Mosdell, W H Daniel and R P Feeborg
Agronomy Journal
Volume 79 Number 4
Pages 720-725
1987

Turfgrass response to applications of soluble nitrogen is characterized by rapid initial growth with a short residual period of response. Compared to soluble nitrogen sources, slow-release fertilizers, such as IBDU and sulfur-coated urea, result in less foliar burn and may reduce nitrogen fertilizer losses. Also, the initial turf response is reduced and duration of response to nitrogen applications is increased. However, slow-release nitrogen sources vary in their nitrogen release patterns.

Oxamide [31 percent nitrogen] is an amide of oxalic acid with a 7:3 nitrogen ratio of oxamide and urea that has potential as a slow-release nitrogen fertilizer in turf. The release of nitrogen from oxamide depends on temperature and particle size. Research has been conducted at Purdue University to compare Wabash Kentucky bluegrass responses, soil inorganic nitrogen in the spring and fall and nitrogen recovery from applications of oxamide, IBDU, sulfur-coated urea and urea. The following results have been reported.

- Recovery of nitrogen in the tissue of Wabash Kentucky bluegrass from applications of coarse oxamide [1 to 2.8 millimeters] was 51 percent compared to 11, 39 and 38 percent for IBDU, fine oxamide [less than 0.85 millimeter] and sulfur-coated urea respectively, averaged over 3 years.
- Initial change in visual turf quality and clipping yields in response to the coarse oxamide was slow and similar to that of IBDU. However, residual nitrogen release was equal to that of IBDU and greater than that of sulfur-coated urea.



- Adding urea to the coarse oxamide increased initial yields and turf quality but reduced the duration of turf response as compared to applications of the coarse oxamide alone.
- At two applications of 2 pounds of nitrogen per 1000 square feet [98 kilograms nitrogen per hectare] oxamide proved to be a good, slow release source of nitrogen.
- At four applications per year, initial clipping yields resulting from spring fine oxamide applications were lower than those from urea, but turf quality in response to residual nitrogen tended to be greater than that of urea.
- Late fall applications of fine oxamide reduced soil nitrate concentrations shortly after application and in early spring as compared to fall applications of urea.
- Oxamide [fine] at four applications generally produced a more desirable turf response than did similar applications of urea.

THE EFFECT OF SEWAGE SLUDGE ON SOIL STRUCTURAL STABILITY: MICROBIOLOGICAL ASPECTS

L Metzger, D Levanon and U Mingelgrin
Soil Science Society of America
Journal
Volume 51 Number 2
Pages 346-351
1987

The application of sludge and of other organic wastes to soils increases the number and size of water-stable aggregates. The capacity of a sludge to increase the structural stability of a soil depends on the properties of the sludge such as degree of stability and carbon to nitrogen ratio as well as on the properties of the soil, such as texture, calcium carbonate and organic mattter content. The microbiological origins of most processes are important in giving rise to improved physical properties in sludge-amended soils. Microorganisms have a dominant role in the improvement in aggregation following the addition of organic materials to soils.

The stability of soil aggregates increases with microbial biomass. Different microbial groups contribute to the formation and stabilization of water-stable aggregates. Mechanisms which promote aggregation are identifiable according to the microorganisms involved. In most cases, fungi are more effective in stabilizing aggregates than bacteria and actinomycetes. Yet microorganisms of different groups may be involved in the formation of water-stable aggregates of different sizes. While large loose macroaggregates [greater than 1 millimeter] are mainly formed by fungal activity, aggregatess stabilized by bacteria are considered to be much smaller [less than 500 micro meters] and more compact.

The microflora promote aggregation either through the mechanical action of fungal and actinomycete hyphae or through the secretion of cemeting substances. Microbial polysaccharides likely play an important role

Actinomycetes

in the formation of water-stable aggregates in soils.

Research at the Agricultural Research Organization, the Volcani Center in Israel has investigated the aggregative efficiency of various groups of complex microflora in soil following the addition of sludge. The following results are noted.

- Fungi make a dominant contribution to the increase in water-stable aggregates following sludge application to soil.

- Both bacteria and actinomycetes had a small effect on the water-stable aggregate formation in the soil-sludge mixtures.

- Filamentous microorganisms [fungi and actinomycetes] developed on the organic substrate form water-stable aggregates by holding soil primary particles together mechanically.

- Extracellular polysaccharides produced by microorganisms also serve as cementing agents and are responsible for the resistance of water-stable aggregates to breakdown upon wetting.

- Microorganisms are attached to clay particles by excreted polysaccharides which cover the bacterial cells or the fungal hyphae. Polysaccharides may therefore play an important role in the formation of water-stable aggregates in sludge-amended soils.

- Fungi, which were found to be the major microbial group responsible for the water-stable aggregate formation, bind soil particles by physical as well as by chemical mechanisms.

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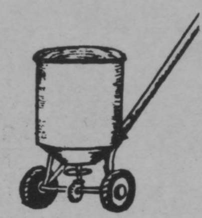


EVALUATION OF DICYANDIAMIDE-AMENDED FERTILIZERS ON KENTUCKY BLUEGRASS

D K Mosdell, W H Daniel and R P Freeborg
Agronomy Journal
Volume 78 Number 5
Pages 801-806
1986

With the increasing cost of nitrogen fertilizers and the potential for nitrate pollution of lakes and groundwater, efficiency of nitrogen management is extremely important. Applications of slow-release nitrogen tend to minimize leaching losses by reducing concentration of nitrate in the soil solution.

The benefits of late-season nitrogen applications to cool-season grasses are well documented. However, the potential for nitrate losses is greatest from fall to early spring when rainfall exceeds evapotranspiration and temperatures reduce plant uptake of nitrogen. Since leaching and denitrification are the primary means of nitrate loss, efficiency in nitrogen management may be improved with nitrification inhibitors.

Dicyandiamide is an organic [67 percent] nitrogen compound which inhibits the cytochrome oxidase involved in ammonia oxidation by Nitrosomonas bacteria. Applications of 10 milligrams dicyandiamide per kilogram of soil have been shown to inhibit nitrification up to 40 days at 68 degrees Fahrenheit [20 degrees Centigrade]. When 20 percent of the nitrogen is applied as dicyandiamide, nitrification of urea and ammonium sulfate were inhibited for 10 weeks. A marked decrease in inhibition of nitrification by dicyandiamide has been noted as soil temperatures increase from 59 to 86 degrees Fahrenheit [15 to 30 degrees Centigrade] and in soils with higher clay and organic matter content.

Most nitrification inhibitors are too volatile for broadcast applications to turfgrasses. Dicyandiamide is a non-volatile inhibitor that can be incorporated into urea and ammonium sulfate granules. Research at Purdue University has been conducted to evaluate urea, ammonium sulfate and a complete fertilizer, all amended with dicyandiamide [so that 10 percent of the nitrogen was in that form] at different application rates and timing for use in the nitrogen fertilization of Wabash Kentucky bluegrass. Comparisons were made with standard turf fertilizers, both soluble and slow release nitrogen sources, to observe any benefits derived from dicyandiamide applications. The following results have been obtained.

- Clipping yields in response to dicyandiamide amended fertilizers were similar to those of urea and ammonium sulfate.

- Initial response to dicyandiamide-amended fertilizers was rapid and response to residual nitrogen shorter than that of IBDU and sulfur coated urea; however, recovery of applied nitrogen in the tissue was similar between dicyandiamide fertilizers and IBDU and sulfur coated urea.

- Averaged over a 3 year period, recovery of nitrogen ranged from 41.1 percent for IBDU to 36.4 percent for ammonium sulfate at 2 times 2 pounds nitrogen per 1000 square feet [98 kilograms nitrogen per hectare], and 39.0 percent for the complete fertilizer plus dicyandiamide to 32.6 percent for ammonium sulfate at 4 times 1 pound nitrogen per 1000 square feet [49 kilograms nitrogen per hectare], respectively.

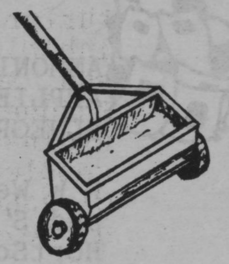
- Turf quality of plots receiving IBDU was superior to all nitrogen sources.

- Measurements 24 days after a November 15 application indicated dicyandiamide inhibited nitrate formation at the 2 times 2 pounds of nitrogen per 1000 square feet [98 kilograms nitrogen per hectare] rate - 13 pounds dicyandiamide per acre [14.6 kilograms dicyandiamide per hectare].

- Fall applied dicyandiamide did not influence soil ammonia and nitrate concentrations the next spring.

- The short period of effectiveness of dicyandiamide would seldom warrant its use as a nitrification inhibitor in turf.

THRESHING THE JOURNALS continued



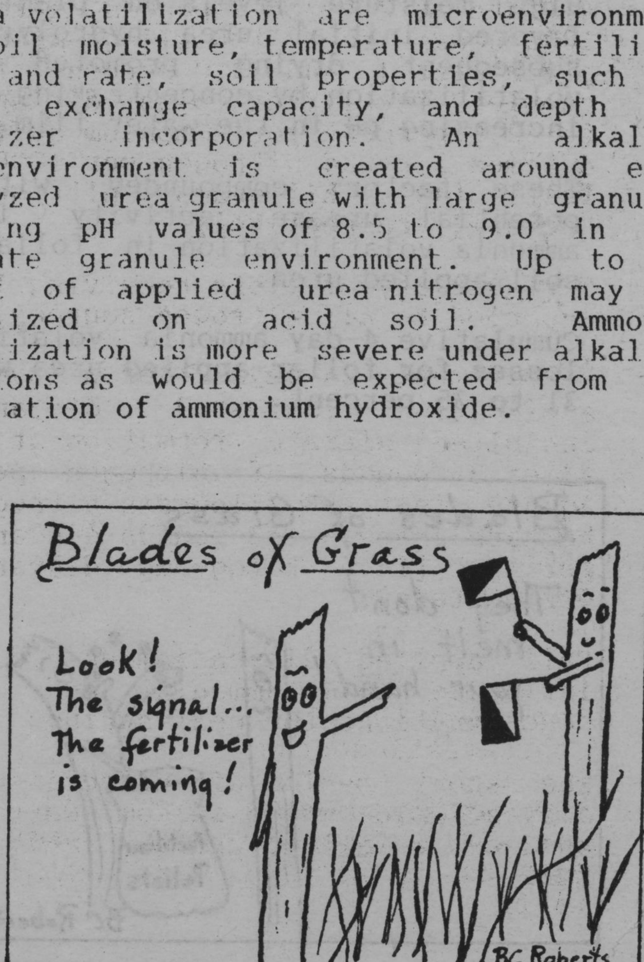
VOLATILIZATION OF AMMONIA FROM GRANULAR AND DISSOLVED UREA APPLIED TO TURFGRASS

S Titko III, J R Street and T J Logan
Agronomy Journal
Volume 79 Number 3
Pages 535-540
1987

Nitrogen fertilization is an important cultural practice in turfgrass management. Recent investigations into nitrogen utilization by plants have indicated that a substantial portion of the nitrogen applied is apparently lost and that crop recovery is often less than 50 percent. Nitrogen may be lost from turfgrass via many avenues, including leaching, denitrification, volatilization and immobilization.

Urea is the most popular nitrogen source of the turfgrass industry because of its high nitrogen content, ease of handling and low cost. Urea undergoes enzymatic hydrolysis to form ammonium carbonate which is very unstable and decomposes to form ammonia. The magnitude of ammonia volatilization losses from urea applied to turf vary. Nitrogen losses from surface applied pelleted urea may reach 20 to 30 percent.

Among the important variables affecting ammonia volatilization are microenvironment pH, soil moisture, temperature, fertilizer source and rate, soil properties, such as cation exchange capacity, and depth of fertilizer incorporation. An alkaline micro environment is created around each hydrolyzed urea granule with large granules producing pH values of 8.5 to 9.0 in the immediate granule environment. Up to 59 percent of applied urea nitrogen may be volatilized on acid soil. Ammonia volatilization is more severe under alkaline conditions as would be expected from the dissociation of ammonium hydroxide.



In an established turf, surface application of fertilizer is the only practical method of fertilization. The nutrients must be solubilized and moved into the root zone for uptake by plants. Frequently the movement of nitrogen into the soil may be delayed or prevented by the turfgrass. Thus, the fertilizer nitrogen remains close to the surface where it is subject to fluctuating moisture levels, high temperatures and microbial degradation, all of which contribute to ammonia volatilization.

Greater ammonia losses have been noted from sod or plant residues than from bare soils. Urease activity can be as much as 30 times greater on leaf surfaces and in thatch than in the underlying soil. Thus, a dense turf provides an ideal environment for urea hydrolysis, if enough moisture is present, and if the urea is in close proximity to the leaf blades or thatch.

Research has been conducted at Ohio State University to assess the effects of temperature, relative humidity, wetting and drying cycles and irrigation on ammonia volatilization from urea applied to turf in a laboratory study. Also the relative ammonia losses from granular and dissolved urea as affected by the variables under study, were compared. The following results have been reported with Merion bluegrass turf.

- Ammonia losses were higher from granular than from dissolved urea in all cases, except where urea application was immediately followed by a 1 inch irrigation [25.4 millimeters].

- Ammonia loss from granular and dissolved urea increased as temperatures increased from 50 to 72 degrees Fahrenheit [10 to 22.2 degrees Centigrade], but there were no effects on ammonia loss as temperature increased from 72 to 90 degrees Fahrenheit [22.2 to 32.2 degrees Centigrade].

- Ammonia losses from dissolved urea at 68 percent relative humidity were greater than losses at 31 percent relative humidity, but ammonia loss from granular urea was not affected by relative humidity.

- Ammonia losses increased rapidly following periodic wetting of the turf fertilized with dissolved urea.

- Irrigation - 1 inch [25.4 millimeters] following urea application decreased ammonia losses from both dissolved and granular ureas.

REDUCING AMMONIA VOLATILIZATION FROM KENTUCKY BLUEGRASS TURF BY IRRIGATION

D C Bowman, J L Paul, W B Davis
and S H Nelson
HortScience
Volume 22 Number 1
Pages 84-87
1987

Volatilization of ammonia following urea fertilization of turf can be substantial and may contribute to reduced plant response. Volatile losses of from 31 to 39 percent of urea-nitrogen applied to Kentucky bluegrass turf have been noted. Losses of 30 to 52 percent have been measured from urea applied to warm season grasses.

Various practices have been recommended to reduce ammonia volatilization from urea, including surface-banding or injecting fertilizer, applying urea to dry or cold soils, mixing fertilizer salts with urea and watering urea into the soil. Irrigation or rainfall following urea application should decrease volatilization, since it positions the urea in a zone with lower evaporation, lower urease activity and higher cation exchange capacity than the surface zone, and it minimizes locally high concentrations of ammonia and ammonium nitrogen.

Research has been conducted at The University of California - Davis to investigate ammonia losses following application of urea in solution to Bensun Kentucky bluegrass turf and to determine the amount of supplemental irrigation required to reduce volatile losses. Results are reported as follows.

- Losses up to 36 percent of the applied nitrogen occurred when urea was applied without irrigation.
- Supplemental irrigation of as little as 2/5 inch [1.0 centimeter] reduced the loss to 3 to 8 percent.
- A 1 3/5 inch [4.0 centimeters] irrigation further reduced losses to about 1 percent.
- Of the ammonia volatilized, most was lost in the first 24 hours.
- Maximum nitrogen loss was associated with the thatch layer, a zone having high urease activity.
- Supplemental irrigation should be applied as soon as possible after fertilization to be effective.

AMMONIA VOLATILIZATION FROM FOLIAR-APPLIED UREA ON FIELD-GROWN KENTUCKY BLUEGRASS

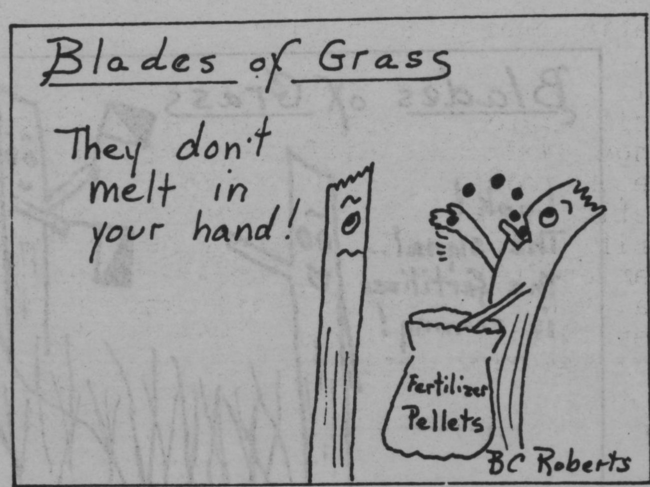
R W Wesely, R C Shearman, E J Kimbacher
and S R Lowry
HortScience
Volume 22 Number 6
Pages 1278-1280
1987

Ammonia volatilization is one component influencing nitrogen-efficiency in turf. Volatilization from soil applied urea and ammonium salts has been noted. Volatilization increases with soil pH and soil drying and decreases with increasing cation exchange capacity and soil moisture.

Urea effectiveness as a foliar nitrogen source has been limited on turf. Positive responses from foliar-applied urea may be confounded by ammonia volatilization losses.

Research at The University of Nebraska has been conducted to assess the extent and magnitude of ammonia volatilization from foliar-applied urea on Park Kentucky bluegrass. Results are noted as follows.

- High ammonia volatilization losses resulted from foliar-applied urea.
- High moisture levels on plant tissue favored initial urea hydrolysis, and subsequent drying promoted ammonia volatilization by concentrating urea and increasing pH in the water film.
- These factors compounded with high potential urease activity increased ammonia volatilization in foliar- over soil-applied urea.
- Cumulative 4-day ammonia volatilization losses for foliar-applied urea were from 31 to 35 percent.



DENITRIFICATION LOSSES FROM KENTUCKY BLUEGRASS SOD

C F Mancino, W A Torello and D J Wehner
Agronomy Journal
Volume 80 Number 1
Pages 148-153
1988

Denitrification loss after nitrogen fertilizer applications to highly managed turfgrass areas has not been researched.

Conditions that may promote denitrification losses include:

- light,
- frequent irrigations,
- fertilizer nitrogen applications,
- incorporation of organic matter into soils,
- higher soil temperatures.

These conditions are found in high-quality turfgrass areas, with the organic matter being contributed by the turfgrass root system. Soil temperatures under closely mowed turf may be high.

Perennial ryegrass swards may lose from 1 to 26 pounds of nitrogen per acre per year [1 to 29 kilograms of nitrogen per hectare per year]. Losses from the grasses are small despite nitrogen applications as high as 10 pounds nitrogen per 1000 square feet per year [500 kilograms nitrogen per hectare per year]. Although peak effluxes from soils under grasses and other crops may be similar in magnitude, the duration is shorter in the presence of grasses due to the grass root system's ability to quickly deplete soil nitrate nitrogen levels. Turfgrass root systems can be shallow due to light, frequent irrigation and close mowing.

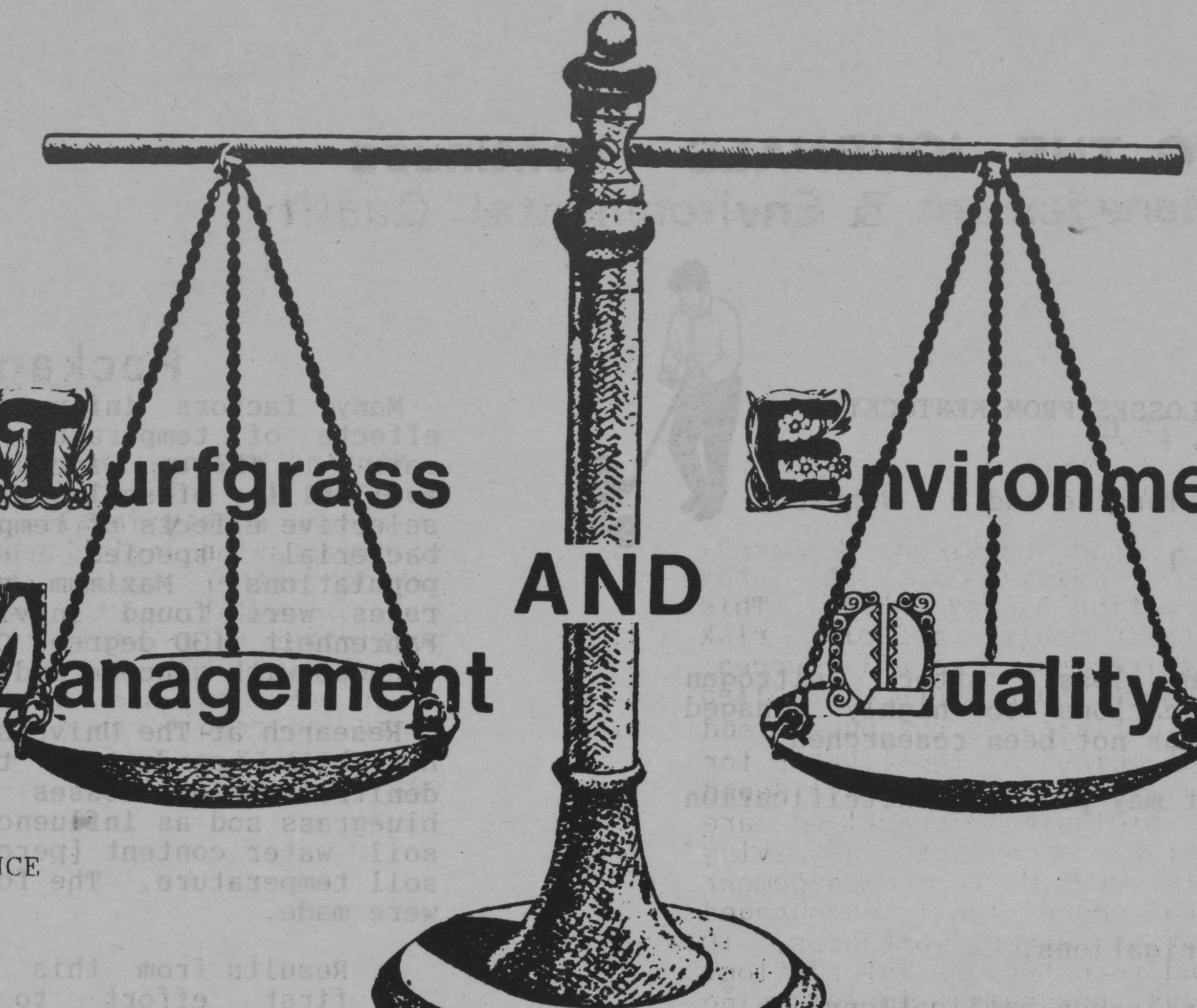
Soil water and texture influence the denitrification process by affecting gas exchange and the diffusion of oxygen to active microbial sites. Small, frequent irrigations have been found to stimulate denitrification, while larger, more frequent irrigations may not. A small water input into a finer textured soil may result in greater denitrification losses than from coarser textured soils.

Many factors influence the quantitative effects of temperature on denitrification rate. These include diversity and availability of soil organic matter and the selective effects of temperature on different bacterial species and denitrifying populations. Maximum soil denitrification rates were found in vitro at 86 degrees Fahrenheit [30 degrees Centigrade] in soils amended with glucose and nitrate nitrogen.

Research at The University of Massachusetts has been conducted to determine total denitrification losses from Baron Kentucky bluegrass sod as influenced by soil texture, soil water content [percent saturation] and soil temperature. The following observations were made.

- Results from this study represent the first effort to directly measure denitrification losses from nitrogen fertilized turf.
- Relatively large populations of denitrifying microorganisms exist in turfgrass soils indicating a high potential for denitrification.
- Denitrification losses from these turf soils were as low as in other cropped soils, until soil water levels approached saturation.
- Saturated soil conditions in combination with elevated soil temperatures resulted in very large denitrification losses from fertilized turf.
- These conditions, in general, do not persist for long periods of time in the field, but large denitrification losses may occur quickly and in relatively short time periods.
- Soil temperatures of 86 degrees Fahrenheit [30 degrees Centigrade] or greater coupled with saturated soil conditions resulted in the greatest losses, equivalent to from 44.6 and 92.6 percent of the applied nitrogen to silt loam and silt soils, respectively. Denitrification losses did not increase at soil temperatures above 86 degrees Fahrenheit.
- These results indicate that denitrification loss from fertilizers applied to turfgrasses may not be a serious problem unless the soils are saturated and at higher soil temperatures.

Turfgrass Management AND Environmental Quality



GCSAA 59th ANNUAL
INTERNATIONAL
GOLF COURSE CONFERENCE

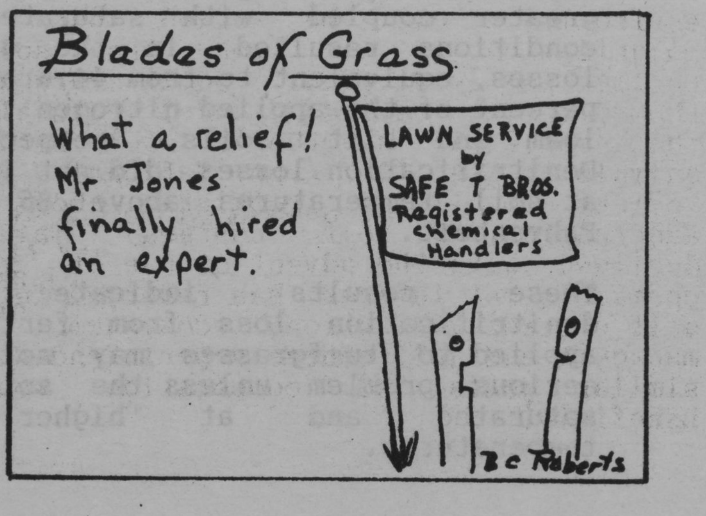
Houston, Texas

February 1-8, 1988

Public issues are so often presented in an either/or context with no middle ground. Certainly ideas range from one end of the spectrum to the other and therefore in some issues, consideration of solutions becomes difficult with the polarization of interested parties.

Risk assessment, where benefits vs risks are considered, is an important step in an issue concerned with health and/or welfare of the public. The Lawn Institute is in the process of developing a comprehensive text on the benefits of turfgrass with a first draft published in the July 1987 issue of Harvests. Requests for this type of information come from a cross section of homeowners, politicians and industry people for in-hand use in procedures of public policy decision making. The media provides a constant barrage of announcements about environmental risks.

Government regulations are known to be a permanent part of the green industry. An understanding of political processes, the workings of regulatory agencies, how environmental groups and turfgrass managers can work together, and current research to find the facts is important. The Golf Course Superintendents Association of America devoted a full morning exploring these various topics. All speakers agreed that safety procedures in handling any chemicals are always important and that label instructions need to be carefully followed.



Turf Pesticides Safe

Dr Richard Cooper, University of Massachusetts, talked about putting toxicity into perspective and concluded that "when used according to label directions, turf pesticides are safe and are not a hazard to the environment."

Turfgrass Management & Environmental Quality continued

EPA

Dr Anne Leslie and Cathleen McInerney represented two divisions of the Environmental Protection Agency [EPA]. This agency has among their goals: reducing risk to man and the environment from all sources; seeking ways to reduce the amounts of applied pesticides; communicating with the public and professionals; and being a facilitator for innovative alternatives to pesticides. Sound cultivation and biological practices are important foundation stones to achieving these goals. Integrated Pest Management [IPM] as a means to reduce risk is encouraged through demonstration areas, workshops, ID kits, research and transfer of information. EPA has numerous programs implementing federal laws on testing, licensing, certification, setting standards, indemnification, disposal, and safety programs. EPA wishes for dialogue with professional turf managers.

GCSAA is cooperating with the IPM unit of EPA which is advantageous for both so that through shared responsibility, learning can take place on the safe use of chemicals and alternatives to chemical controls for the sake of beautiful and safe golf courses.

Cooperation

C William Black of the Congressional Country Club, Bethesda MD, recognized the need to work with governmental regulatory agencies in order to develop fair and enforceable regulations. Demonstrations and facts on the use of mini-boom sprayers as a method safer than hand-held equipment was an input into a recent controversy about use of one chemical on golf courses which helped turn the tide so that use of the chemical on certain areas can be continued. Golf courses, when safely maintained, are areas where wildlife can find homes which adds to the enjoyment of the site.

Packaging

Martin McGinn, W A Cleary Corporation, Somerset NJ, pointed out how society today is demanding safety in all areas - water, food, transportation, neighborhoods. Industry is taking further steps through new packaging and formulation to make application of pesticides safer so as to protect people and animals and still have good golf courses. Great progress has been made through the years and credit is given to the cooperation of industry and GCSAA members working together.

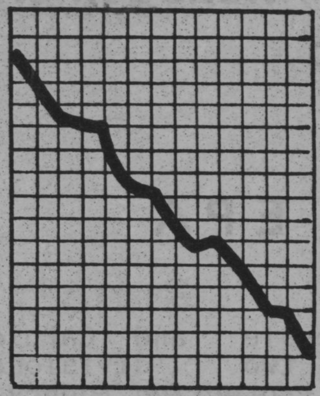
Audubon

Maureen Henkle and Jeffrey Froke of the National Audubon Society spoke about the tensions that exist between proposed/existing golf courses and neighboring communities. Both sides should be sensitive to the concerns of the other and dialogue encouraged early on so that issues of land use and safe environment can be worked out before polarization is so strong that solutions become really difficult. Golf courses lend themselves to having planned natural areas that serve as sanctuaries for birds and animals. In 1917 the National Audubon Society published booklets about bird sanctuaries on golf courses. This idea declined with the advent of use of stronger chemicals but interest has resurged in having golf courses as strong ecosystems. Refuge managers and golf course superintendents have similar goals so cooperation would be beneficial.

Turfgrass Management & Environmental Quality continued

Lobbying

During the past two years Richard Marks, Fairview Country Club, Greenwich CT, has learned a great deal about lobbying on the state level. Staying within the ethics guidelines is very important. After a bill is passed, it is too late to counter its effects. State capital offices are helpful in educating those interested in participating in the process of lobbying. Elected senators and representatives look for sound, factual material on which to base their votes. Negotiation between opposing ideologies can result in a legislative package that works for both sides.



Reducing Risks

Dr Redmond Clark, Hasco International, Reston VA, deals with issues on how to reduce risks and control liabilities. He predicted that additional legislation will bring more regulations regarding the use, management, disposal and cleanup of chemicals on golf courses. Chemicals will be managed from the day they are ordered to the day they cease to exist. The regulations are complicated and too often the attitude of the turf manager is not to bother to comply until enforcement is engaged. Although the number of inspections is few, there are realities that need to be considered - concerns about getting caught not following regulations; possible litigation from a variety of sources; clean up necessary in order to transfer property; and the right to know regulations - all of which are excluded under general liability policies. It was emphasized that superintendents put the following into place in their programs:

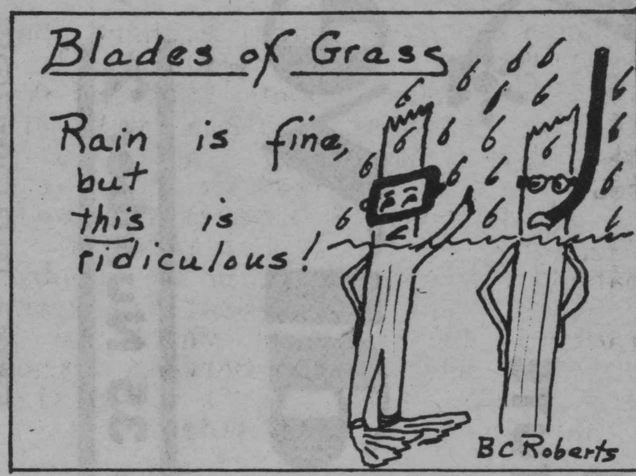
- Be aware of regulations;
- Improve use of safety equipment even for small jobs;
- Improve storage of chemicals;
- Improve ventilation;
- Improve disposal of hazardous wastes;
- Move towards nontoxins wherever possible;
- Tie in with EPA;
- Keep good records in order to prove 30 years from now that you complied.

Past practices maybe worked, but they are not good enough for today.

Turfgrass Management & Environmental Quality continued

Runoff

Dr Tom Watschke, Pennsylvania State University, reviewed his ongoing research on surface runoff in turf [Harvests October 1987] which is important input into the high national priority for water quality and quantity. Pesticides can attach to sediment which moves with water from agricultural lands. There has been evidence that grass strips in cultivated land reduce this movement. This research on highly managed turf will impact on more urban settings and land use. Preliminary results show that managed, thick turf reduces water runoff, increases water infiltration, and buffers any loss of nutrients so that water is cleansed. This endorses the premise that turf has an important value in helping to maintain a high quality environment.



Thatch

Dr Harry Niemczyk, Ohio State University, is conducting research on the movement and fate of applied insecticides on turf. Most information about this issue now comes from cultivated agricultural sites. Answers to the question: what happens to applied pesticides after irrigation ? are being sought. Some insecticides are more soluble than others so a variety of chemicals are being used. Tests for over three years have shown that when thatch is present, the amount of insecticide that moves after irrigation into even the first inch of soil is very small. Where thatch is not present, there is movement of pesticide into the soil. It seems that the organic thatch layer is a barrier to chemical movement. Grubs live at the soil/thatch interface, construct tunnels and injest a considerable amount of organic matter, thereby also injesting the insecticide. Conclusions to date have shown that post application irrigation safens the environment; improves grub control; and does not enhance movement of insecticides through the thatch to the soil profile.

Microbial breakdown is natural and this helps degrade chemicals applied to turf. It has been noted with interest by Dr Niemczyk that after repeated applications of similar chemicals, microbial breakdown becomes faster than normal as these organisms use the pesticide as a source of carbon [energy], and therefore the insecticide is not available long enough to be effective in targeting the insect. Rotation of use of chemicals may or may not be successful but doesn't seem to be the solution. It is hoped that this phenomenon of accelerated degradation can ultimately be managed and used to advantage.

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Lawn Institute Harvests is published four times a year by The Better Lawn and Turf Institute. The headquarters office address is P O Box 108, Pleasant Hill, Tennessee 38578-0108. Phone: 615/277-3722. Inquiries concerning all aspects of this publication may be addressed to the headquarters office.

The Better Lawn and Turf Institute is incorporated as a nonprofit business league formed exclusively for educational and research purposes concerned with agronomic, horticultural and landscape concepts.

Lawn Institute Harvests is dedicated to improved communications among turfgrass seed and allied turf industries and other firms, businesses, organizations and individuals with lawngrass research and educational interest and concerns.

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Printer: Crossville Chronicle (Tennessee)