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## Summer 1973

J. B. Weber

T. J. Monaco


A. D. Worsham

Malcolm R. Forbes

Robert W. Schery

*See next page for additional authors*

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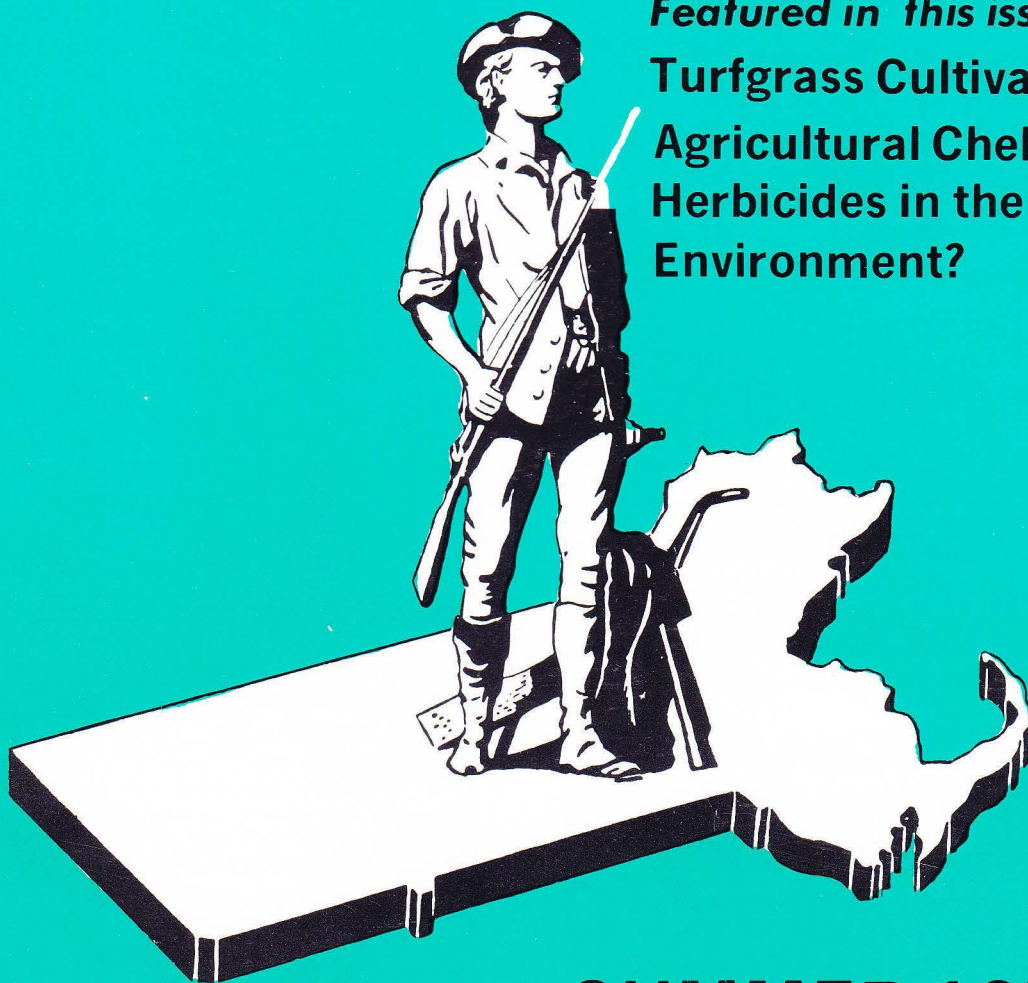
**Authors**

J. B. Weber, T. J. Monaco, A. D. Worsham, Malcolm R. Forbes, Robert W. Schery, and Robert A. Matthews

# TURF BULLETIN

MASSACHUSETTS TURF  
AND LAWN GRASS COUNCIL  
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**Turfgrass Cultivars**  
**Agricultural Chelates**  
**Herbicides in the**  
**Environment?**



**SUMMER 1973**

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William F. Clark  
Rm. 10, Stockbridge Hall  
UMass., Amherst, Mass.

SECRETARY-TREASURER & ADVISOR  
Dr. Joseph Troll  
RFD No. 2 Hadley, Mass.

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Reprinted from "Weeds Today" Vol. 4, No. 1

## What Happens to Herbicides in the Environment?

J. B. Weber, T. J. Monaco and A. D. Worsham

A few years ago the question of what happens to herbicides after application was of interest mainly to agricultural scientists. But not any more. In today's ecologically-oriented society, there is strong interest in all aspects of pesticide use. In fact, whether the essential agricultural herbicides continue to be legal for use may well depend on educating the public about the ultimate fate of herbicides in the soil, in the air and in water.

Such things as the use of 2,4,5-T in Vietnam, with publicity about possible harmful effects of dioxin (a contaminant present in small amounts), has brought about a general change in attitude about herbicides. Press reports now refer to "biocides," "plant exterminators and annihilators," and "deadly chemical toys" instead of favorable terms like "chemical plows" and "weed killers" that were formerly used. A syndicated newspaper columnist recently referred to several herbicides as "potential baby de-formers." Available to counter this bad press is a wealth of research information that explains the fate and behavior of these agricultural chemicals after introduction into the environment. Such information conclusively establishes safety of herbicides use. The critical need is to share these facts with our urban neighbors.

The following discussion of various processes acting on herbicides in the environment points to the complexity of the problem, but it should provide a clearer understanding of what actually takes place. Also obvious is the need for continuing research to ensure future safety as new herbicides become available and new techniques are adapted. Such investigations should tell what happens to the active herbicide applied, accounting for each degradation product remaining, amount lost in the air, and amount present in plants or microbes at the end of the experiment.

### Forces That Act on Herbicides

Once herbicides are introduced into the environment, outside forces immediately begin acting on them. Both herbicide degradation processes and herbicide transfer processes play a part in determining the ultimate fate of the chemicals.

Three specific degradation processes serve to break down the herbicides and change their chemical composition:

1. Biological decomposition — degradation by a living organism.
2. Chemical decomposition — breakdown by a chemical process in the absence of a living organism.
3. Photodecomposition — degradation by purely chemical processes involving radiant energy (sunlight).

Six transfer processes are important in determining

what happens to herbicides in the environment:

1. Absorption and exudation by plants and animals — herbicides can either penetrate through tissues into an organism (absorption) or be discharged from inside an organism to the surrounding environment (exudation).

2. Retention in vegetation and then transference in the harvested product.

3. Adsorption by soil particles, a process by which herbicides transfer from solution or vapor to a solid surface (soil particle).

4. Movement through the air and into the atmosphere. This is the result of volatilization, by which the herbicide is changed from the solid or liquid state into a gas or vapor form.

5. Surface runoff of herbicides into ponds, rivers, and oceans. The herbicide may be either dissolved or suspended in water or be adsorbed to eroding soil particles from treated areas.

6. Movement through the soil, either laterally, as liquid or gas, or vertically (downward by capillary flow).

(Continued on Page 4)

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(Continued from Page 3)

**Degradation Processes**

**BIOLOGICAL DECOMPOSITION.** Biological decomposition of herbicides includes detoxification by plants and soil microorganisms. This breakdown process involves several mechanisms.

Herbicides may be absorbed by plants and microorganisms and stored or given off in their original form. Usually they are changed, however, and the breakdown products are either used by the organism or plant or discharged back into soil solution. In some cases, herbicides are retained within the tissues of the plant or organism, thereby delaying decomposition.

Herbicides may be removed from treated fields if the compounds are present in harvested plant parts, but amounts removed are nearly always insignificant. For example, 1 p.p.m. (part per million) of a herbicide in a 10-ton hay crop amounts to only 0.02 lb. per acre removed in the hay. However, sizable amounts can be degraded by plants during a cropping season.

Common and Trade Name of  
Herbicides Mentioned in  
This Article

Common Name	Trade Name
chloramben	Amiben
picloram	Tordon
2,4-D	many
bromoxynil	Bucril
amitrole	Weedazol
paraquat	Paraquat
trifluralin	Treflan
diquat	Diquat
TCA	Sodium TCA
dinoseb	several
monuron	Telvar
diuron	Karmex
fluometuron	Cotoran, Lanex
benefin	Balan
propachlor	Ramrod
propanil	Rogue
EPTC	Eptam
vernolate	Vernam
CDAA	Radox
molinate	Ordram
dichlobenil	Casoron
DCPA	Dacthal
pebulate	Tillam
chlorpropham	Chloro IPC
2,4,5-T	many

**CHEMICAL DECOMPOSITION.** Several processes account for chemical decomposition of herbicides:

1. Oxidation is a degradation reaction in which a compound loses electrons, as in the case of 2,4-D oxidation.

2. Reduction is an opposite reaction in which a compound gains electrons. As in the case of oxidation, this changes the compound from its original form and makes it less stable.

3. Hydrolysis is a degradation process by which addition of water forms different compounds.

The decomposition products are normally non-toxic substances that are further degraded to components similar to organic molecules commonly present in soils and plants. Some are more readily degraded in the adsorbed state and others less so.

**PHOTODECOMPOSITION.** A herbicide applied to plant foliage or the soil surface is subject to decomposition by action of sunlight. Most organic herbicides are susceptible to a certain amount of photodecomposition, such as 2,4-D, chloramben, picloram, bromoxynil, amitrole, trifluralin, and paraquat.

Water soluble herbicides are carried into soil by rainwater, and this reduces their decomposition. Incorporating these chemicals into the soil practically eliminates breakdown by photodecomposition.

**ADSORPTION.** Adsorption — the process by which herbicides are attached to particles of soil—has a lot to do with how herbicides behave in soils. The organic materials, humus and humic acid, along with inorganic materials like the clays, montmorillonite and vermiculite, and the hydrous oxides of iron and aluminum are soil particulate matter responsible for adsorption and inactivation of herbicides.

The adsorption process greatly affects absorption rate of chemicals by plants and other organisms. Thus, it helps determine herbicide performance. Changing of a herbicide from solid or liquid to a gas is affected by attachment of the chemical to soil particles. Adsorption also has a lot to do with how chemicals move in liquid—downward leaching or upward movement by capillary action.

Several processes explain how herbicides are retained by soil colloids through adsorption. Positively charged (cationic) herbicides like diquat and paraquat are strongly held to soil by ionic bonds, much like potassium and calcium are held. Negatively charged anionic herbicides—2,4-D, chloramben, picloram, TCA, dinoseb, and bromoxynil—are not readily adsorbed because they have the same negative charges as the soil particles. However, small amounts may be bound to positively charged soil colloids like iron and aluminum hydrous oxides.

Small amounts of neutral or non-charged (molecular form) herbicides may be retained at the soil surfaces through weak physical forces. Certain non-ionic herbicides are adsorbed to soil particulate matter through relatively weak physical forces. These include the phenylureas (monuron, diuron, and fluometuron), the substituted anilines (trifluralin and benefin), the substituted anilides (propachlor and propanil), the thiocarbamates (EPTC and vernolate), and the miscellaneous ones (molinate, CDAA, dichlobenil, and DCPA).

**VOLATILIZATION.** Herbicides that have evaporated (undergone volatilization) are present as gases in the atmosphere, where the sun may break them down. Incorporating herbicides into the soil greatly reduces volatilization loss, particularly with chemicals that evaporate

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(Continued from Page 4)

readily. Those ranked medium to high in volatilization are more efficient when incorporated.

Whether a herbicide is likely to evaporate is indicated by the vapor pressure rating, which is generally available from the manufacturer. The higher the vapor pressure the more volatile is the herbicide.

Soil texture, temperature, and moisture content also affect volatilization. Losses generally decrease as size of soil particles decrease. Thus, there is faster vaporization on coarse textured than on fine textured soils. Higher temperatures and moisture contents also speed up herbicide volatilization. There is less loss when highly volatile herbicides are applied to cool, relatively dry soils.

Trifluralin, dichlobenil, and chlorpropham are rated "somewhat volatile;" "highly volatile" is the classification for CDAA, EPTC, vernolate, and pebulate.

**HERBICIDE RUNOFF.** Herbicides applied to the soil surface may dissolve in rainwater and be leached into the soil. Or heavy rains may carry them away from treated

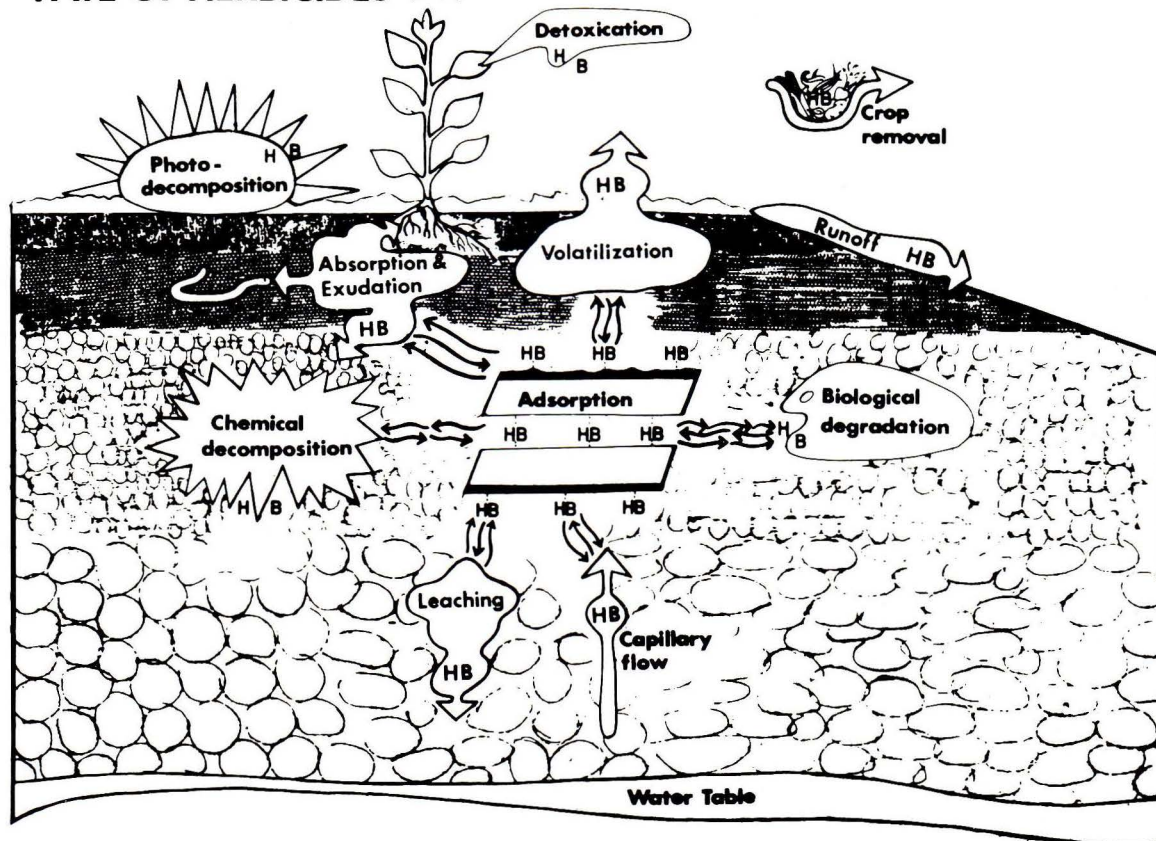
areas. Severe runoff can also carry soil particles with adsorbed herbicides off with eroding soil and water. "Wash-off" is the term used to describe such losses.

#### All Processes Associated

All processes involved in herbicide degradation are intimately associated. Adsorption, which directly influences all others, is probably the key process. The transfer processes are usually reversible and in dynamic equilibrium with the system. Cationic herbicides like diquat and paraquat are exceptions since they are irreversibly adsorbed between sheets of certain clay minerals. Their molecules are held so tightly that they are neither degraded nor released from the soil particles. All other herbicides are in a reversible equilibrium state and are subject to breaking down in soil systems.

Except for gross misapplication and overuse, the degradation processes described will break herbicides down into safe or nontoxic compounds. **There is no evidence of potential build-up or persistence in the soil to contaminate the environment.**

### FATE OF HERBICIDES (HB)



Processes influencing the behavior and fate of herbicides in the environment. Degradation processes are characterized by the splitting of the herbicide (HB) molecule. Transfer processes are characterized by the herbicide (HB) molecules remaining intact.

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Jan.-Feb. 1973 Vol. 17 No. 1

## Agricultural Chelates - What They Are, What They Do

By Malcolm R. Forbes  
Hampshire Chemicals  
Nashua, New Hampshire

1. che-late /ke-lat/ n (GREEK chele claw, hoof) a cyclic molecular structure, usually containing 5 or 6 atoms in a ring, formed by the residual valences of neighboring atoms, in which a central metallic ion is held in a coordination complex.

2. chelate vt: to combine with a metal so as to form a chelate ring.

If the above definition of a chelate makes a lot of sense to you, don't bother to read any further. You probably know enough about chelation already. If it does not help much, let's see if it is possible to come up with a more practical explanation.

In agricultural fertilizers, chelates help to prevent micronutrient deficiencies in many types of crops. Among the metal micronutrients available as chelates are iron, zinc, manganese, and copper. In chelated form, the metal ions are protected by a cage-like chemical ring which alters the electronic charge from positive to negative, making it impossible for the metal ions to be precipitated by phosphates, carbonates, and other soil and fertilizer components. Thus, chelated micronutrients remain mobile and unfixed, allowing them to move freely in soil solutions for uptake by plant root systems.

It would be far simpler to explain the process of chelation if we could see the actual shapes and sizes of molecules. They would be as easy to tell apart as it is to tell a pick-up truck from a tractor. Just as the shape, size, and other characteristics determine what can be done with a tractor or pick-up, the shape, size, and electrical charge determine what a molecule can do.

Molecules are built from standard parts which can be put together in a certain order to give the required chemical characteristics. Because EDTA is the most common and versatile of commercially available agricultural chelating agents, let's use its molecular structure as an example of what a typical chelate is and what it does.

When a chemist describes a molecule, he takes the names of its individual parts and runs them all together. This can result in some real tongue twisters, such as EthyleneDiamine TetraAcetate, the correct name for EDTA. Separating this into its parts we get: Ethylene Diamine Tetra Acetate. The first letters give us EDTA.

"Ethylene" is the name for a 2-carbon chemical linkage. In this case, it forms the backbone for the rest of the parts making up the molecule. (Figure 1)

"Diamine," Di-is the Latin word for two and -amine is one of the chemical names for nitrogen. It has the same derivation as ammonia. Two parts of nitrogen are added, one at each end of the ethylene "backbone." (Figure 2)

"Tetra Acetate." Tetra is the Latin word for four. Acetate is the chemical name for a particular type of acid group. Two of these groups are attached to each nitro-

gen. As can be seen in Figure 3, the acetate groups each have a single negative (—) charge. This is the basic structure of EDTA.

When a metal ion approaches a molecule of EDTA, the "claw" definition of the chelate becomes clear. Typical of most metallic micronutrients, the metal ion possesses a double positive (+) charge. The metal and EDTA are strongly drawn together by their opposite charges.

Figure 4 shows a metal chelated or "captured" by EDTA. Both of the plus (+) charges from the metal have reacted with and been neutralized by two of the negatively charged (—) acetate groups, forming the ringlike structure mentioned in the dictionary definition. At the same time, a special type of bond has been formed between the metal and the nitrogens of the chelate. This type of bond results from the sharing of electrons and is called a covalent bond.

Finally, EDTA and the particular metal involved form a very stable chemical structure with four bonds, two ionic and two covalent.

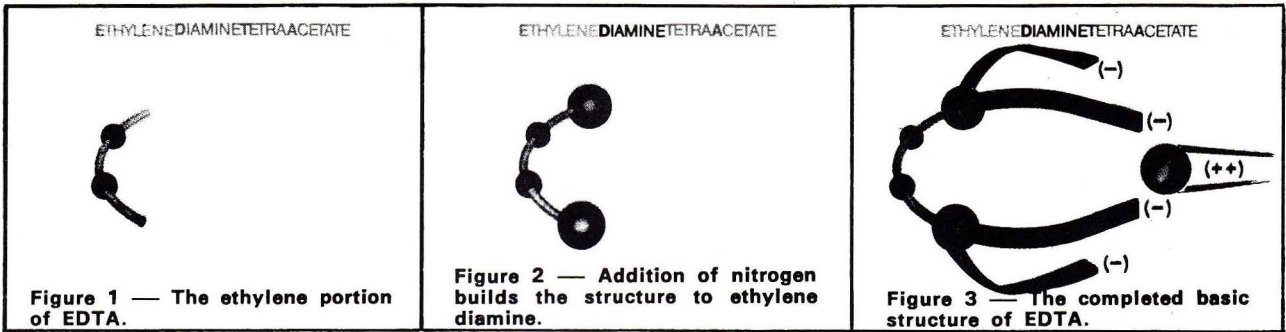
The unusual properties of chelates are partly due to this multiple bonding. Looking at Figure 4 again, two unused negative (—) charges can be seen. This means that the metal chelate has a double negative (—) charge which is residual and responsible for the rest of the chelate's properties.

In order to understand these additional properties, it is necessary to consider the chemical reactions between various micronutrient sources and different fertilizer materials in solution. When chemical salts are dissolved in water, an anion(—) and a cation (+) result. Here are a few common fertilizer materials and their ions.

Each of the materials shown above is water soluble and gives a clear solution. Problems may arise when solutions are mixed. In solution, ions having opposite charges are free to react with each other. If the product of this reaction is insoluble, precipitation will occur. As an example of compatible materials, zinc sulfate when mixed with ammonium nitrate could form zinc nitrate and ammonium sulfate. Both of these materials are soluble and no precipitation occurs. On the other hand, when zinc sulfate and diammonium phosphate are mixed, ammonium sulfate (soluble) and zinc phosphate (insoluble) are formed.<sup>1</sup> The precipitation of zinc by diammonium phosphate is so complete that it is described in chemical literature as a quantitative analytical procedure. The phosphate anion (—) is one of the chief fertilizing materials that will precipitate micronutrient metals, all of which have positive (+) charges.

(Continued on Page 8)





## ZINC ETHYLENEDIAMINETETRAACETATE

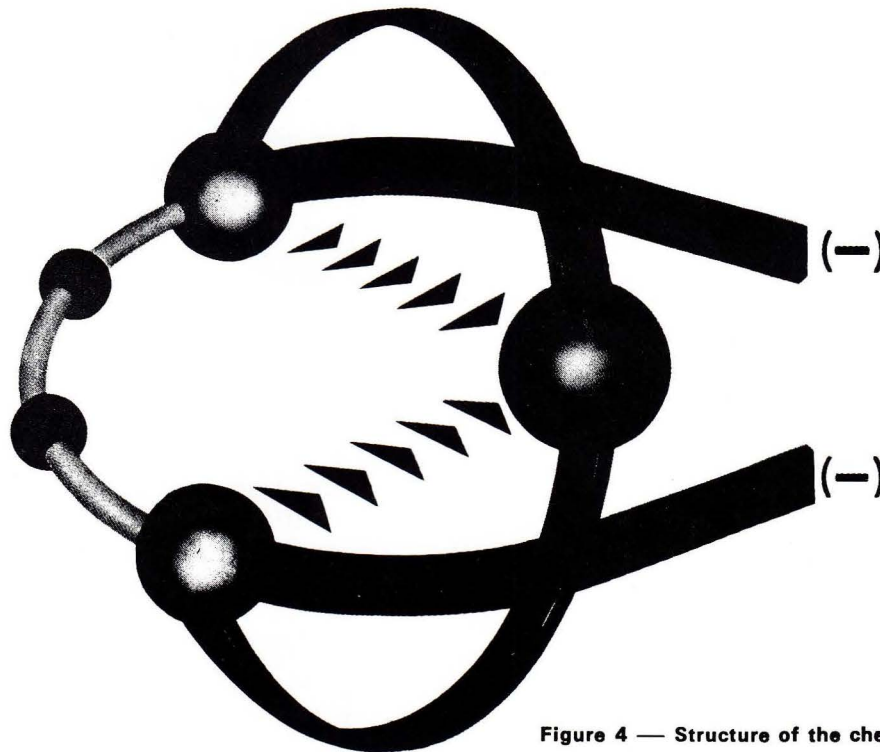


Figure 4 — Structure of the chelated metal.

Material	Formula	Cation (+)	Anion (-)
Ammonium Phosphate	$(\text{NH}_4)_2\text{HPO}_4$	2 $\text{NH}_4 +$	$\text{HPO}_4 =$
Ammonium Nitrate	$\text{NH}_4\text{NO}_3$	$\text{NH}_4 +$	$\text{NO}_3 -$
Zinc Sulfate	$\text{ZnSO}_4$	$\text{Zn} ++$	$\text{SO}_4 =$
Disodium Zinc EDTA	$\text{Na}_2\text{ZnEDTA}$	2 $\text{Na} +$	$\text{ZnEDTA} =$

(Continued from Page 6)

As mentioned above, when zinc is chelated it becomes a part of the anion (—). Because ions with the same charge do not react, phosphate will not precipitate the chelated metal. With some so-called sequestering agents, the action of the phosphate is usually vigorous enough to break the metal-agent bond. The multiple bonding with EDTA, however, is strong enough to resist this attack.

The other significant aspect of metal chelate behavior occurs in the ground and has to do with the exchange capacity of various soils. Clays, for example, have negative (—) surface charges which attract and hold positively charged (+) metal ions. Although these clays act as a storage reservoir for metals present in large quantities, such as calcium or magnesium, the effect on the trace quantities of micronutrient metals present is to reduce the amount of available metal to a level insufficient for best plant growth. Because of the negative (—) charge of the metal chelate, it is not attracted to these clays and stays free and mobile in the soil solution.

With ever-increasing crop yields and use of high yield hybrids, more trace minerals are required by plants. These micronutrients, of course, are removed from the field along with the plants when crops are harvested. Also, higher application rates of phosphate and other major nutrients limit the availability of essential micronutrients. Insufficient amounts of trace metals often account for reduced yields, even though sufficient levels of major nutrients are present.

The prevention of micronutrient deficiencies in crops is preferable to correcting them after symptoms appear, although this can often be accomplished by prompt foliar application or side dressing. Following the recommended practice, the micronutrient should be applied with fertilizer before or at planting. Chelated micronutrients will help correct deficiencies by allowing the essential metal to move to the root zone for rapid and efficient plant absorption.

<sup>1</sup>It is beyond the scope of this article to go into the specific nature of the precipitated zinc salts. For a further discussion of the exact products, see J.H. Lehr, Chemical Reactions of Micronutrients in Fertilizers, Micronutrients in Agriculture, Soil Science Society of America, Madison, Wisconsin, 1972.

#### The Author

Malcolm R. Forbes is a micronutrient specialist with Hampshire Chemicals, a division of W.R. Grace & Co., in Nashua, N.H. A graduate of Columbia University with a degree in chemistry, he has previously held research positions with General Foods, Stauffer and American Cyanamid.

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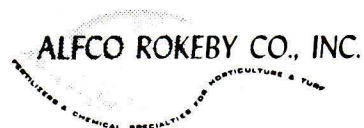
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## TURFGRASS CULTIVARS

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### What Constitutes a Modern Lawngrass "Variety"

Gardeners familiar with woody plants (most of which are propagated clonally) and garden annuals (the seed for which is generally a "pure line" or a controlled  $F^1$  hybrid) may be confused by the diversity of genetic forms turfgrass cultivars or "varieties" assume. The cultivars are given unlatinized popular names the same as other horticultural varieties—e.g., 'Highland,' 'Fylking,' 'Penn-cross,' and others. The specific name, of course, is latinized, as are any botanical subspecific epithets — e.g. "*Festuca rubra* var. *commutata*," Chewing's fescue. But the genetic basis for the cultivars and their modes of propagation vary widely. The range extends from merely adventive (natural) populations molded physiologically by the environment (viz. 'Arboretum' Kentucky bluegrass) to highly sophisticated intraspecific hybridizations (and less frequently interspecific ones, which have not proved overly useful) such as have been conducted by Dr. Reed Funk at Rutgers University.

A cultivar once perfected may be maintained by any of a number of techniques that include clonal propagation (notable with golf green bentgrasses and the finer bermudagrass hybrids), seed maintained essentially as a "pure line" by rogueing of off-types to a standard, and random crossing from proscribed parental lines (three clonally maintained lines in 'Penn-cross' creeping bentgrass, sixteen "pure line" parent stocks in the multiline 'Manhattan' perennial ryegrass, over a dozen mostly apomictic bluegrass lines in 'Park' Kentucky bluegrass). Maintaining reasonable genetic uniformity in crop after crop of polycross seed harvests requires frequent fresh planting into fields free of the species, lest one of the parental lines become dominant and overshadow others. In the case of 'Penn-cross' creeping bentgrass, growers in the association have agreed that for certification a seed field will be in production for three years only.

It is impossible to generalize as to which of these procedures is most satisfactory for yielding good turfgrass cultivars. Keep in mind that more so than with most garden plants, turfgrasses are called upon to endure a great diversity of habitat, growing conditions, and methods of maintenance (or lack of it). For general lawn usage heterogeneity (as exemplified by the mixing of cultivars or the use of heterozygous material) has better satisfied needs than has homozygosity and a narrow genetic base that typifies most garden and crop cultivars. With durability of more concern in the lawn than exact morphological homogeneity, it is no wonder that turfgrass breeding programs have been somewhat slower to develop pedigreed grass lines than has been the case with garden plants grown for flower and fruit. Moreover, some of the most important turfgrass species—notably Ken-

tucky bluegrass—are so complicated genetically that established crop breeding techniques accomplish little.

On the whole cultivars of southern turfgrasses — those adapted to warm weather and planted from the border states southward — are most "conventional." Where planted by seed a general population may be used that is not characterized by cultivar definition (e.g. common bermuda or centipede; with bahiagrass a few standard cultivars are used with little attempt to refine the bloodlines). Ready sexual crossing and recombination keeps bermudagrass selections from coming true-to-type from seed, and the finer cultivars (many of them developed by interspecific crossing), must be maintained by clonal separations. This is relatively simple with an aggressive, fast-moving species such as bermuda, where stolons can be scattered much as is seed for making new starts.

Very much the same system is used with zoysia. Local selections or ecotypes ('Emerald' is a man-made hybrid, however) are maintained by clonal planting of sprigs or plugs. So far St. Augustine grass, the sole native species much utilized for turf, has not proved economically amenable to propagation by seed (little is set), and the relatively few selections which have been made and given cognizance as cultivars are, like the common grass, propagated vegetatively. Even with centipede, of which seed is available (although of very small size and quite expensive), vegetative propagation rather than seeding is usual.

Although turfgrass breeding programs are gaining impetus in the South, on the whole there has been rather little isolation and accumulation of breeding stock. The screening of large progeny populations from the crossing of common bermudagrass with African bermudagrass has been the most rewarding source of distinctive, fine turf cultivars (most of them, incidentally, sterile triploids).

Turning to northern turfgrasses, the situation becomes more complicated. This is particularly true with Kentucky bluegrass, a polyploidaneuploid with an apparent base chromosome number of 7 and with variable chromosome counts (often variable within the same cultivar) even exceeding 150. Natural interspecific crosses and introgression are probably involved, and "*Poa trivialis*" may have played a part. So great is the potentiality for genetic variation in "wild" adventive stands of Kentucky bluegrass in North America, that early plant breeders believed it rather pointless to attempt hybridization within the species. Dr. Funk has since, of course, shown the advantages of utilizing select genomes. But it is true that in the long course of evolution from a putative diploid perhaps in southeastern Europe, to the widely naturalized bluegrass found in all temperature climates today, that nature has played upon the tremendous variability within

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the species to create untold biotypes and ecotypes. The main source for bluegrass cultivars has been simple selection of "strains" (usually a clone) showing outstanding features when kept as mowed turf. 'Merion,' one of the first and perhaps the most outstanding of such discoveries, was simply noted growing upon the apron of a green at the Merion golf course near Philadelphia. Most of the many cultivars on the market are simply "strains" picked up in this same fashion.

The searching out of bluegrass selections advanced earlier in Europe than in the United States, largely because of proprietary protection there (a "breeder's rights" law was not enacted in the United States until 1971). Probably because of a more continental climate in most of the United States than in Europe, European selections have often proved less satisfactory than domestic ones for the United States, with occasional notable exceptions ('Fylking' and 'Baron' cultivars, from Sweden and Holland respectively, have achieved top ratings in American tests; 'Sydspport' and others look quite promising at this time). 'Nugget,' an Alaskan find, has proved a particularly interesting case; it reflects its northerly heritage by later growth in spring than other cultivars, but is a top performer of great attractiveness during the long days of summer.

Bluegrasses are to a greater or lesser degree apomictic, seed generally being from an unreduced egg not fertilized by the pollen. The degree of sexuality has been shown to vary, greatly from strain to strain, somewhat (at least in certain cases) with latitude, and with growing conditions (natural outdoor pollination showed less sexuality at Rutgers than forced flowering in the greenhouse). Funk's work clearly indicates that the tendency towards apomixis can be inherited, and that even highly sexual lines can sometimes have their better traits bred into highly apomictic lines to create a desirable hybrid sufficiently apomictic to merit commercial development. Obviously, once an outstanding bluegrass is selected or bred, it is economically most desirable to propagate it and offer it for sale as seed; the seed will come true-to-type only to the extent that the selection is apomictic. Cultivars brought to market are generally highly apomictic, often ninety-seven or ninety-eight percent so (and the remaining small percentage of off-types mostly represent weak recombinations that are overwhelmed in the population). However, the degree of apomixis is evaluated by progeny test, and human judgment enters the picture in deciding whether or not certain of the progeny are "untypical." In some cases qualified experts have disagreed materially about the sexuality of the same cultivar. In any event, for most bluegrass cultivars on the market today the original selection is propagated through seed, and its restricted heredity is preserved through apomixis rather than through clonal separations (although there are a few vegetatively propagated bluegrasses being offered). Roguing in the seed production fields, and replanting from breeder sources, pretty well keep the cultivars true-to-type.

Sufficient bluegrass selections from nature have been made now, to create quite a bank of select germplasm for the plant breeder to work with. At Rutgers University, for example, hundreds of thousands of selections have been evaluated, most of them discarded, the remainder husbanded for breeding potentialities. Dr. Funk and his students have learned how to achieve crosses even of highly apomictic selections, and have been quite successful in developing a considerable number of hybrids of desirable appearance, performance, disease resistance, apomixis, and so on. It has been found that with most strains that pollination must take place shortly after midnight (in the greenhouse) in order to have male gametes present sufficiently early during egg meiosis to achieve a worthwhile, though small, degree of fertilization. Hot water emasculation has generally proved satisfactory for panicles of the female parent. Many of the hybridizations achieved seem to be of a triploid nature, probably involving an unreduced egg and a reduced male gamete. We won't try to discuss the intricacies of bluegrass genetics here, but the end result of Dr. Funk's work has been for the first time to combine characteristics from select bloodlines in a directed fashion rather than depending upon chance reassortment in nature.

The restricted heredity represented in apomictic lines and hybrids has the same advantages and disadvantages inherent with any crop. To overcome the disadvantages most bluegrass seed is offered in mixture, two or more cultivars or species being combined. That way the risk against some newly mutated disease or other hazard is reduced. Although many of the exclusive "fine points" characteristic of a cultivar are overshadowed in mixtures or multiline seed plantings, the blend should show some adaptability advantages, as in the case of the 'Arboretum' and 'Park' populations previously mentioned.

The situation is a little less involved with fine fescues. Most cultivars are simply selections carried to pure line standards. Until recently fescues were not so intensively collected as bluegrasses and proven bloodlines have been meager. Differences between cultivars seems not so pronounced as with bluegrasses. Most older cultivars such as 'Illahee,' and even new ones such as 'Jamestown,' are nothing more than especially successful clones that were come upon accidentally. 'Pennlawn,' however, represents a deliberate polycross effort involving three parental lines selected at Pennsylvania State University for disease resistance. 'Highlight' and 'Ruby' are European introductions which have adapted well to America, the former a "show" Cheewing's fescue ("F. rubra var. commutata") and the latter a "creeping red" selection ("F. rubra var. rubra").

Bentgrasses constitute a rather complex group, and experts are still not certain where to place a cultivar such as 'Highland' taxonomically. 'Highland' is a natural ecotype, probably stemming from south German bent introductions, that has proved remarkably successful in the Cascade mountain foothills of Oregon where it has natural-

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ized very effectively. Inexpensive, high quality seed of this cultivar has dominated the colonial bentgrass market in America. 'Astoria' is a similar chance selection from nature, while 'Exeter' represents a more deliberately developed cultivar inbred at the University of Rhode Island (and hence more uniform than 'Highland' or 'Astoria'). Colonial bentgrasses are adapted to humid, maritime locations, and are more used as the underpinning for fine turf in England and northern Europe than they are in continental climates of the United States, although 'Highland' has exhibited good drought resistance.

Creeping bentgrasses have been used mostly for golf greens. By-and-large they have been picked up as unusually successful clones on golf greens in various areas, and are perpetuated vegetatively by the planting of stolons (they do not come true-to-type from seed). Adventive creeping bentgrasses on the Oregon coast have dominated certain localities to become biotypes there, the best known

of which is the highly variable 'Seaside.' However, more recently specifically tailored 'Penncross,' a polycross mentioned earlier, has dominated the creeping bentgrass seed market, being more disease resistant than other cultivars, vigorous, and convenient to start from seed. Velvet bents are not widely planted because of the intensive care that they require. However 'Kingstown' is a new inbred from Rhode Island University that shows promise of greater uniformity and easier culture.

The fine-leaf perennial ryegrass cultivars are newly important, used in certain climates alone, and rather generally in small proportion as nursegrasses or for winter-seeding. Selections such as 'NK-100,' 'Pelo' and 'Combi' have enjoyed popularity, but perhaps most distinctive is 'Manhattan,' a multiline combination of sixteen clones picked up mostly as ecotypes hanging on in Central Park, New York, by Dr. Reed Funk.

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MAJOR TURFGRASSES OF THE U.S.A.	REPRESENTATIVE CULTIVARS	MAJOR USES	CONSTITUTION	PROPAGATION
Kentucky bluegrasses, "Poa pratensis"	'Arboretum,' 'Arista,' 'Baron,' 'Fylking,' 'Merion,' 'Nugget,' 'Pennstar,' 'Prato,' 'Sydsport'	lawns and athletic fields; best on good soils and when moder- ately tended	quite varied and complex genetic- ally; ecotypic, pure line, hybri- dized, and multi- line (partial polycrossing).	mostly highly apomictic seed
Rough bluegrass, "Poa trivialis"	none	damp shade, and win- ter seeding of golf greens in the South	unselected for homozygosity	seed, not selected for true breeding characteristics
Colonial bentgrasses "Agrostis tenuis"	'Exeter,' 'Highland,' 'Holfior'	low-mowed turf espe- cially in humid locations, irrigated golf fairways	sexual, ecotypes and selected lines	homozygous and heterozygous seed
Fine fescues, "Festuca rubra" (including var. "commutata," the Chewing's fescues)	'Cascade Chewing's,' 'Illah- hee,' 'Golfrood,' 'Highlight,' 'Jamestown,' 'Pennlawn,' 'Rainier,' 'Ruby'	in bluegrass mix- tures, especially adapted to infer- tile, light soils and shade	sexual; pure lines in isolation, or occasionally poly- cross	true-breeding seed
Creeping bentgrasses, "Agrostis stolonifera" ("A. palustris")	'Penncross'; vegetative golf green selections such as 'Cohansey,' 'Congressional,' 'Toronto,' etc.	highly kept luxury turf, especially golf greens.	Penncross is a tailored polycross; other seed more heterogeneous	select seed and clonally
Velvet bentgrass "Agrostis canina"	'Kingstown'	as for creeping bent	inbred line	reasonably homo- geneous seed
Perennial ryegrasses, "Lolium perenne"	'Combi,' 'Manhattan,' 'NK-100,' 'Pelo'	quick cover, special maritime locations, and athletic fields where winter not too severe	pure lines and multiline (poly- cross)	homozygous and tailored polycross seed
Bermudagrass, "Cynodon dactylon and its interspecific crosses	'Ormond,' 'Santa Ana,' 'Tif- dwarf,' 'Tifgreen,' 'Tifway'; common	fine lawns and golf greens; common seeded for general cover	strongly sexual and heterozygous heteromorphic from seed	named cultivars clonally; common from heterozygous seed
Centipede, "Eremochloa ophiuroides"	'Oklawn'	minimum care lawns	heterozygous	vegetatively or by unselected seed
St. Augustine, "Stenotaphrum secundatum"	'Bitter Blue,' 'Floratine'	lawns of deep South and Gulf area, shade tolerant	variable	clonally and vegetatively
Bahiagrass, "Paspalum notatum"	'Argentine,' 'Paraguay,' 'Pensacola,' 'Wilmington'	coarser lawns of deep South	reasonably pure lines by cultivar	fairly true-breed- ing seed by variety but heterozygous within variety

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There are no named cultivars of rough bluegrass, "Poa trivialis," of which seed is imported from Europe for such limited use as the species enjoys on this continent. Redtop has long been utilized as a nursegrass, along with annual ryegrass, and is harvested from unselected adventive stands in the Midwest where it thrives in moist locations.

Thus it is apparent that lawngrass cultivars represent many patterns of origination and practical propagation. Many are simply ecotypes of adventive grass, sorted out by natural selection. Some are honed to a fine edge by elimination of off types through selection and inbred rogueing, their characteristics perpetuated as a pure line or protected through vegetative propagation (including apomixis). Still others are the result of deliberate breeding programs, for which sufficient germ-plasm has only in recent years become available. The trend is in this direction, with the diversification that has proven useful in lawn culture being obtained through mechanical blending of different varieties or through the polycross technique (where several outstanding selections are planted together and let cross as they will) rather than through use of highly variable, unselected strains. Each "variety" must be considered individually for an understanding of its origin and genetic identity. The accompanying chart summarizes the situation for major American turfgrass species.

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# VANDALISM ON THE GOLF COURSE

by Robert A. Matthews

Student of Turf Manag., Stockbridge School of Agric.

Vandalism has been a serious problem to many people and civilizations throughout man's existence on this earth. The first vandalism in our world was probably performed by an early cave man upon another's cave or food supply due to jealousy or hunger. The most noted instance of vandalism in history relates to a Teutonic race of people in the fourth and fifth centuries, whose name became the word we use today. Known as the Vandals, this group of people occupied an area in north east Germany between the Vistula and Oder rivers. Through migrations, they were joined by other groups and settled in a part of Beuticæ, which they called Vandalitia. In 429 A.D., by command of Bonafacia, Governor of Africa, these warlike nomads crossed the Strait of Gibraltar under the leadership of the dreaded Genseric, and reared destruction and ruin from the Atlantic coast to the frontiers of Cyrene, in the Balkan Mountains. Their devastation included works of art, literature, and government in such places as Gaul, Spain, Northern Africa and Rome, and was so overwhelming that their name has remained on the tongues of man for fourteen centuries. In 477 Genseric met death, but was followed by his son Hunneric, who hideously persecuted and tortured the Catholics and held the entire Mediterranean area in terror by his maniacal piracies and actions. So stems the origin of the word vandal.

Webster has this to say of the word vandal—one who wantonly damages or destroys property of beauty or value. The New Century Dictionary's definition goes even deeper—one who willfully or ignorantly destroys artistic or literary treasures, or wantonly attacks or mars anything that is beautiful or venerable, hostility or contempt for what is beautiful or venerable. This definition touches closest to vandalism on golf courses, since golf courses are both beautiful and venerable, due to their age, stature and value.

Vandalism has occurred in every country and culture throughout the world, regardless of social or economic levels, or geographic boundaries. Vandalism can be a serious and costly threat to the superintendent of a golf course. In almost all cases vandalism is not premeditated and is a senseless, pointless and expensive act. And very often, the act of vandalism causes frustration and anger for the superintendent as he views the loss or damage which the vandal has left behind.

No one knows what causes or motivates people to commit such mindless and costly acts. Many people try to explain them as results of boredom or the search for excitement, the high regard for toughness or being "in" or many other reasons. In some cases the vandal's deed is his declaration of defiance to a community or society that he does not understand or is not a part of. Today's society

seems to invite and promote vandalism with its themes of violence and aggression so apparent and heavily played upon by movies, books, television and news broadcasts. This partly lies in the character of the times, a period of social upheaval and change in the attitudes of youth, and partly in the undefinable nature of the vandal. In an editorial in "Life" magazine it is said "The real causes of vandalism are the steady abdication of adult authority over the past few generations, and the erosion of our sense of pride in the community." Cornell psychologist Urie Bronfenbrenner attributes the rise in both vandalism and drug abuse in youth to changes in parental attitudes and parental neglect.

Years ago when someone caused damage or destruction to someone else's property, they were forced to repair it by elders or people in authority. Too much of this destruction is let pass by unrepaired or paid for today by authorities, and the youth are quickly acquiring the attitude that they may wreck and steal their surroundings at will. Just as with the drug problem, the problem of vandalism can no longer be associated with only lower class people. Fordham sociologist John H. Mater says "the vandal is no longer exclusively among the underprivileged or the poor, nor can he be classified along racial, ethnic or even economic lines."

Vandalism does, however, cater to one particular group of society, and that group is youth. Nearly eighty per cent of all vandalism suspects arrested in 1971 were under the age of eighteen, and many of these individuals seemed to care little of the society their fathers built. This large number of minors puts law enforcement people in a bad position, since the methods of punishment for youth today are limited and usually very mild. In most cases, a convicted youthful vandal is fined and his father must foot the bill, or he is given a suspended sentence or probation, neither of which can be very rigidly or closely enforced. Very rarely are there cases in which a youthful offender will be sent to a jail or reformatory school over a matter of vandalism. And another unfortunate factor which is present is that police are able to make arrests on only two to three per cent of all acts of vandalism which are reported.

A number of factors can influence the amount of vandalism which a golf course may receive. The most important factor would probably be the location of the course. A course located in a city or municipal area would undoubtedly receive many more incidents of vandalism than a course located in a rural, country area. It is a known fact that municipal golf courses are often bothered

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with gangs or groups of kids who inflict damage regularly to courses, because of the large number of bored and thrill-seeking youths found in a city. City police also have much more important issues on their schedules than patrolling golf courses for wandering kids. Many metropolitan golf courses are accustomed to these attacks of vandalism and have necessary measures of prevention already in use, including fences, good lighting in access areas, and even night watchmen and night patrols on the course.

It is of no wonder than many city courses suffer frequent attacks. Many youthful residents of cities don't get the opportunity to enjoy wooded lands and nature as much as suburban youngsters, and sneak out on a golf course to enjoy the beauty and splendor not found elsewhere amid the dirt and cement of a city. Many youths originally intend no harm, and just want to relax in the woods or find a nice spot to make out with their girlfriend or drink beer with friends. But too often, the intentions of these wanderers become changed by alcohol or the search for some sort of excitement or thrill, and result in damage to greens, trees or golf carts, or the theft of flagsticks, benches and tee markers. In the winter the desire to go sledding down the soft rolling hills or skating on the ponds result in extensive damage to the turf hidden below.

Golf courses which are located in isolated country areas are also very vulnerable to vandals, due to their open surroundings and easy access by unwanted people. Here again the attraction of the hills and ponds bring out the sledders, skiers, skaters and a larger and much more threatening problem, snowmobiles. The snowmobile problem, however, is one which is more controlled and enforced by regulations and laws or club official's decisions, rather than in the hands (and hair) of the superintendent. Youths are attracted onto a golf course many times by curiosity or the urge to discover someplace new. Whatever the reason a person is drawn to a golf course at night, the results of the visit are more often than not, undesirable to the golf course.

The cost of vandalism varies greatly from club to club, but in every instance it is much too high. Superintendents, in many cases, must spend thousands of dollars for repair of damages and replacement of stolen supplies that could be spend on the betterment of the course. Through questioning of superintendents and research, I found not one golf course which had escaped paying out great sums of money for repair of the deeds of vandals. The following are examples of exactly how much the problem of vandalism can cost the golf course.

Audobon Country Club in Louisville, Kentucky, reports \$5,000 to \$10,000 in damages yearly, including damages to greens and fairways by sledders, ice skates and mini-bikes, damages to their golf carts and theft of flagsticks, trees for Christmas time and shrubs, and miscellaneous equipment essential to their operation of the course.

Waterbury Country Club, of Waterbury, Connecticut, totals the figure at \$2,000 loss due to stolen supplies (flagsticks, tee markers, benches, hoses and sprinklers) and at least \$3,000 damage yearly to greens and fairways.

Lakewood Golf and Country Club in New Jersey has been more fortunate than the average. They figure the loss is about thirty-five to fifty flagsticks at \$20.00 each or about \$1,000 yearly.

At Cottonwood Country Club in El Cazon, California, the superintendent, Harry Stadille, reports "considering labor, materials, loss of play and revenues we've spent \$10,000 to \$20,000 to completely replace greens which have been damaged by automobiles spinning tires over them."

Van Cortland Park and Golf Course, Bronx, New York, America's oldest municipal golf course, suffered frequent damages including one incident involving minibikers which cost the club \$10,400 to repair damage to a green and tees.

Paul Couture, superintendent at Plandome Country Club on Long Island says "The kids run wild over the course at night. I find flagsticks and tee markers thrown in bushes and trees. My best preventative, since the club

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cannot afford fencing of the area, is to hire an assistant who will live on the course and play watchman as much as possible.

To show that golf courses are not the only organizations affected by the high cost of vandalism, I have included some figures that illustrate what other institutions must pay. In New York City schools, vandals caused a total amount of \$6,500,000 in damages and thefts in one year, 1971. The U.S. Office of Education in Washington reports that it costs the taxpayers of this nation one hundred million dollars a year for damages to public schools across the country. The Telephone Company also foots an expense of approximately \$10 million a year from damages to phones, booths, poles and equipment. These figures are astounding, yet it is happening every day to property, public and private.

At Middleton Golf Course, a public course where I was once employed, frequent thefts of flagsticks on summer nights necessitated bringing them in every night. Tee markers had been appearing everywhere except where they were placed, including across the neighboring highway, in the roughs and, worst of all, in the ponds. The superintendent combated this by making his own tee markers. These markers were made of wood to make them float, and large and brightly colored to be easily found when removed. Halloween night will find this superintendent at his course, making frequent checks for trouble-making spooks.

This illustrates another important point, that vandalism is not only a large source of money loss to a golf course, but also an inconvenience, aggravation, and a cause of much lost time to the superintendent and his crew. This is time which could be better spent improving the course and maintaining it at a top level of condition. And as "Time" magazine had to say "Far more serious

than the economic costs of vandalism, which are incredibly high, are what is revealed about the state of mind of those committing it, and about the society which merely shrugs it off."

This brings us to the measures of prevention that can be initiated to decrease the problem of vandalism on golf courses. There have been many proposals and ideas on the subject, but surely the one that has proved most popular and effective has been fencing. Although the idea is not new and is far from being an absolute solution to the problem, it is a great factor in reducing the number of potential vandals on a course. A fence not only keeps out unwanted vandals, but it also serves to lessen the number of lost or dangerously flying golf balls, unwanted animals such as dogs, and also helps to protect neighboring families' children from the dangers of ponds, machinery or the golfers' drives which are hard to see and can cause much pain to a youngster. In a number of cases, golf courses have been held liable for damages when a youngster has wandered onto a course and been hurt by machinery or drowned, due to the club not having a fence and promoting what the law defines as an "attractive nuisance."

We must remember, however, that a fence will serve only as a deterrent and, as the saying goes, "keep out the honest people." Someone who is intent on getting over or through a fence, whether by climbing or with wire cutters, is not going to be stopped by any fence, regardless of size. As an example, most everyone has seen youths and older adults as well clambering over a chain-link fence to get into a football game or sold-out concert. The only way a vandal of this type can be stopped is probably by armed watchman. However, most vandals are not this intent and will merely go to a course with easier access to commit their crimes.

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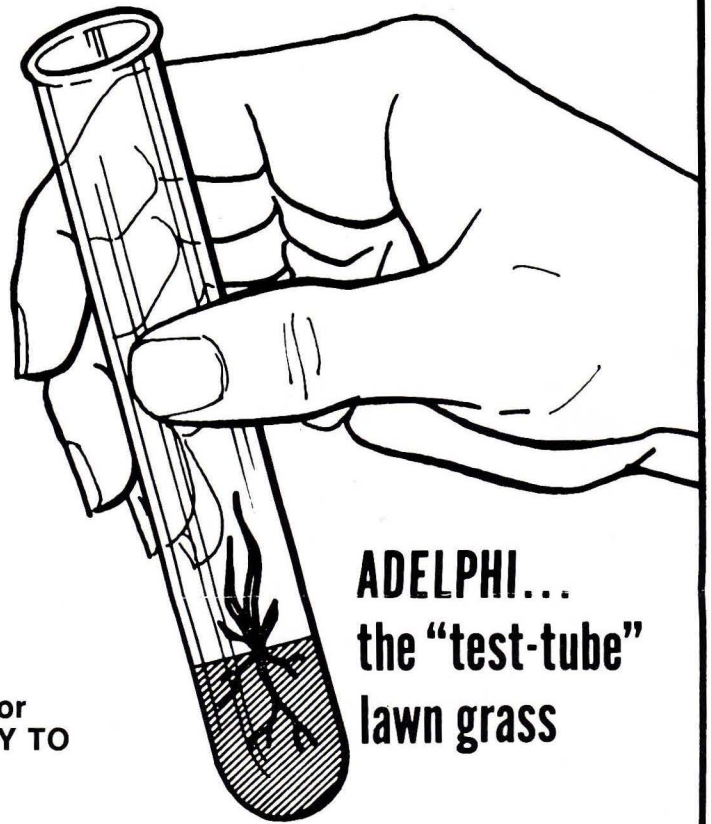
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The expense of a fencing job can be great and many have to be stretched over a period of a few years by even wealthy clubs. Not all areas of a course will need to be fenced in, such as forest land and areas where there is no access or only light travel. Still, the average number of feet for a typical golf course can be between 10,000 and 20,000 linear feet. When you figure that a good quality chain-link fence sells for between \$3.50 and \$5.00 per linear foot, you are speaking in terms of between \$40,000 to \$100,000 for a complete purchase and installation.

The job of installing a fence is not one for the maintenance crew of a golf course, and should be contracted to the lowest bidding company. These contractors have all the necessary equipment and experience for completing the job quickly and easily, and can install up to one hundred yards per day with a three man crew. Not long ago the Country Club of Waterbury, Connecticut, decided fencing was necessary to the upkeep of their course. The superintendent at Waterbury, Charles G. Baskin, decided that a chain-link fence eight feet tall with three strands of barbed wire extending on foot would give maximum protection at a minimum of maintenance. Installation price was bid lowest by Cyclone Fence Company, at \$4.40 per-linear foot, which was slightly higher than average due to the extreme hilly contour which the fence would follow. He chose H-shaped posts rather than the conventional hollow tubular type, due to their strength and the fact that the hollow posts tend to corrode at a quicker rate. His crew undertook the task of clearing the area in which the fence installers would work, and the installation was closely watched for damage to trees, post depth, alignment of the fence and traffic patterns used by the installers on the course. Upon completion, the installation of 16,000 feet of fence had taken one and a half years at a cost of over \$70,000 to the club. However high it may

seem, the club officials have deemed the project a sound investment and an effective deterrent to the vandals which had previously been costing them \$2,000 a year for theft of items and over \$3,000 for damages to the course each year.

A number of other factors must be considered when installing a fence around a golf course. The most important factors are the laws governing where and how a fence may be put up. These laws differ with each city, state or town and are essential to follow, since a mistake will mean that the fence may have to be moved or taken down at the club's expense.

This brings us to the problem of property lines. Property lines must be found and marked, by surveying or locating maps, deeds, aerial photographs or previously placed markers. If surveying is necessary it can be costly, but should be done periodically whether installing a fence or not. The maintenance crew must prepare the area for the installation, usually clearing a five to ten foot swath for maneuvering of fencers and the cement truck. Where trees are to remain near the fence, it must be prearranged with the contractor (probably at a small additional charge.) Regulations concerning the use of barbed wire must be checked since laws vary from place to place. In some areas, barbed wire cannot be used near where houses and estates are located, and decisions must be made where barbed wire or plain type wire will be used. As you can see, installation of a fence is a big and complex job at a very large cost, but is being proved effective in reducing stolen equipment, damages to the course, lawsuits to the club and general aggravation of the hardworking superintendent.

Among the other methods of prevention being initiated is that of better lighting of access, clubhouse and maintenance areas on the golf course. Lighting has

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proved to be a valuable deterrent to crime in our city streets, parking lots and public walkways as well as on the golf course. The cost is minimal and the results are excellent.

Another method often used is the use of a night watchman, security guard or motorized night patroller. This method has met with good results to many clubs, but can often be quite expensive and only be afforded by very wealthy clubs. Many superintendents are now taking an idea from this theory and providing living quarters for a placement student or the assistant superintendent, who can make frequent checks of the course by merely walking around outside their apartment or by use of a golf cart or truckster to check the entire course. The mere fact that a vandal knows someone is living on such an area provides a valuable deterrent to potential vandals. This solution has been used by superintendent George Thompson at his club in Chevy Chase, Maryland, with excellent results. Some clubs are even going as far as to have the superintendent's home built right on the course, such as Kayem Oviau has at the newly constructed Glen Oaks Club on Long Island. This not only provides the deterrent to crime that is wanted, but also proves desirable for many other reasons.

Some clubs have resorted to sending out letters or bulletins, asking the cooperation of neighbors and surrounding land owners in keeping a watch out for vandals, and in educating their children to the dangers of wandering on a golf course. This seems to be the theme for many successful programs which clubs are initiating, including education of the people to the beauty, value and high costs of such damages to country clubs in their area, and a bringing together of the community through cooperation and coexistence with their surroundings. This may mean a day or two lost in a season for the purpose of a community

function such as a picnic, golf, swimming and explanations of activities at the club and the value of a club to its community. This may seem far-fetched, but is actually being done by some clubs in the Chicago area and resulting in a large decrease in vandalism and also some new memberships. Quoting an editorial on vandalism in "Life" magazine, "The solution lies in restoring the outsider's lost faith in the community."

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## Massachusetts Seed Laws

### INFORMATION REQUIRED ON ANALYSIS TAGS

#### (A) Agricultural Seed, Including Lawn Seed Mixtures. Each container.

1. Commonly accepted name and variety. In the case of Buckwheat and kinds shown under the latest revision of section 201.10(a) of Rules & Regulations of the Federal Seed Act when the variety is unknown seed shall be labelled "Variety Unknown." Will automatically change whenever there is a change in the federal Seed Act. When more than one component is required to be named, the word "mixture" or the word "Mixed" shall be shown conspicuously.
  - a. Commonly accepted name and variety of each seed component in excess of 5% of the whole and for white clover and *Agrostis* spp. (including crop bentgrasses & redtop) constituting less than 5%, in the order of its predominance under the separate headings "Fine Textured Grasses" and "Coarse Kinds." The following shall be named as "Fine Textured Grasses": colonial bentgrass (*Agrostis tenuis*), creeping bentgrass (*Agrostis palustris*), velvet bentgrass (*Agrostis canina*), Kentucky bluegrass (*Poa pratensis*), rough bluegrass (*Poa trivialis*), wood bluegrass (*Poa nemoralis*), Canada bluegrass (*Poa compressa*), red fescue (*Festuca rubra*), chewing fescue (*Festuca rubra* Var., *commutata*), and sheep fescue (*Festuca ovina*). All other kinds must be listed under the heading "Coarse Kinds." "Other crop seed," "weed seed," and "inert matter" must be listed under the heading "Other Ingredients."
2. Lot number or other identification.
3. The origin, if known, of alfalfa, red clover, white clover and field corn (except hybrid corn). If the origin is unknown that fact shall be stated.
4. The percentage by weight of all weed seeds.
5. The name and number of each kind of "restricted" noxious weed seed per pound when present.
6. The percentage by weight of agricultural seeds other than those named on the label, or voluntarily named which may be designated as "other crop seed."
7. The percentage by weight of inert matter.
8. For each named agricultural seed:
  - a. The percentage of germination, exclusive of hard seed.
  - b. The percentage of hard seed, if present.
  - c. The calendar month and year the test was completed to determine such percentages.

NOTE: For preplanted containers, mats, tapes and other devices.

The minimum number of seeds per square foot is required.

#### (B) Vegetable Seeds.

1. For peas, beans and sweet corn in containers of one pound or less, and all other kinds of vegetable seeds in containers of one-quarter pound or less: (Seeds of peas, beans, and sweet corn in containers holding one pound or less, other vegetables in containers holding one quarter pound or less and seeds of flowers in containers of the size for use in home flower gardens, which are allowed to be labeled with the calendar year for which the seed is packaged in lieu of the date of germination test are not exempt from the requirement of Section 261B to be tested for germination, unless specific exemptions are provided.)
  - A. The date of test or calendar year for which seed is packaged.

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(Continued from Page 20)

- B. The kind and variety of seed.
- C. For seed that germinates less than the standard last adopted by the director:
- Percentage of germination, exclusive of hard seed
  - Percentage of hard seed, if present.
  - The calendar month and year the test was completed to determine such percentages.
  - The words "Below Standard" in not less than 8 point type.
- D. For peas, beans and sweet corn in containers of more than one pound and all other kinds of vegetable seeds in containers of more than one-quarter pound:
- The kind and variety of seed.
  - Lot number or other lot identification.
  - Percentage of germination, exclusive of hard seeds.
  - Percentage of hard seed, if present.
  - For seed germinating less than the standard, the words "Below Standard" in not less than 8 point type.
  - The calendar month and year the test was completed to determine such percentages.

NOTE: For preplanted containers, mats, tapes and other devices.

The number of seeds in container is required in addition to other requirements.

**(C) Flower Seeds.**

For those kinds of flower seeds where there are annual, biennial and perennial sorts, or any two of such sorts a statement in a conspicuous location on the seed container to indicate whether the seed is of the annual, biennial or perennial sort.

- For flower seeds in packets for use in home flower gardens:
  - The date of test or calendar year for which seed is packaged.

- Name of the kind and variety (if any) or a statement of type and performance characteristics as prescribed in regulations.
- For those kinds of seeds for which standard testing procedures shall have been adopted, and which germinate less than the standard last adopted by the director and approved by the commissioner:
  - Percentage of germination, exclusive of hard seed.
  - Percentage of hard seed, if present.

(Continued on Page 22)

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(Continued from Page 21)

- c. Calendar month and year the test was completed to determine such percentages.
  - d. The words "Below Standard" in not less than 8 point type.
2. For flower seeds in containers other than packets prepared for use in home flower gardens:
- A. Name of the kind and variety, if any, or a statement of type and performance characteristics as prescribed in regulations.
  - B. Lot number or other lot identification.
  - C. For kinds of seeds for which standard testing procedures shall have been adopted:
    - a. Percentage of germination, exclusive of hard seed.
    - b. Percentage of hard seed, if present.
    - c. For seeds germinating less than the standard, the words "Below Standard" in not less than 8 point type
    - d. The calendar month and year the test was completed to determine such percentages

NOTE: For preplanted containers, mats, tapes and other devices.

The number of seeds in container is required in addition to other requirements.

**(D) Tree and Shrub Seeds, in containers of quarter pound or more.**

- (1) The kind of seed and the variety.
- (2) The percentage by weight of pure seed.
- (3) The percentage of germination of those kinds for which standard testing procedures have been adopted.
- (4) The year of collection of such seed.
- (5) The specific locality (State and County in the United States or nearest equivalent political unit in the case of foreign countries in which the seed was collected). If origin is unknown, that fact shall be stated.
- (6) The range of elevation at which seed is grown or the statement "elevation unknown."

- (7) The date of test or calendar year for which seed is packaged.

NOTE: For preplanted containers, mats, tapes and other devices.

The number of seeds in container is required in addition to other requirements.

**NOXIOUS WEEDS**

**Prohibited**

- Canada thistle—Cirsium arvense.
- Field bindweed—Convolvulus arvensis.
- Quackgrass—Agropyron repens.

**Restricted**

- Annual bluegrass-Poa annua
- Bedstraw—Gallum Spp.
- Buckhorn plantain—Plantago lanceolata.
- Corncockle—Argostemma githago.
- Dodder—Cuscuta spp.
- Horsenettle—Solanum carolinense
- Perennial sow thistle—Sonchus arvensis.
- Wild garlic and Wild onion—Allium spp.
- Wild mustards—Brassica spp. Wild mustards are limited to the three species India mustard, (Brassica juncea), charlock or wild mustard (B. kaber) and black mustard (B. nigra) and seeds of these plants must be labeled as "Restricted noxious weed seeds."
- Wild radish—Raphanus raphanistrum.

If any Restricted Noxious Weed Seeds occur, the name and number per pound must be listed under the heading Restricted Noxious Weed Seeds.

**Other Weed Seeds**

Black medick or yellow trefoil (Medicago lupulina), sucking clover (Trifolium dubium), and large hop clover (Trifolium campestre) are classified as weeds, in Massachusetts and may not be included with other crop seeds in any analysis except when labeled and offered for sale as a crop seed and occurring as the principal component of the lot.

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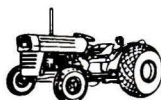
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(Continued from Page 22)

**PROHIBIT THE SALE, OFFERING OR EXPOSING FOR SALE OF SEEDS:**

1. Unless the test for germination has been completed within a nine-month period, exclusive of the month in which the test was completed and provided, further, that the records of such tests shall be available to the commissioner or his duly authorized assistants for a period of at least one year from date of test.
2. Containing prohibited noxious weed seeds.
3. Consisting of or containing "Restricted" noxious-weed seeds at a rate per pound in excess of the number declared on the label attached to the container of the seed or associated with the seed, subject to tolerances.
4. Containing more than one per cent of all weed seeds.
5. Sell, offer or expose for sale any color mixture of a single kind of flower seed representing four or more colors or shades, in which any one color or shade occurs in sixty percent or more of the plants which the mixture is capable of producing, unless colors or shades and approximate percentage of each is indicated on the label.
6. Sell, offer or expose for sale a mixture of flower seed kinds in which any one kind is present in excess of twenty-five per cent by seed count unless the kinds present and the approximate percentage of each are indicated on the label.
7. Agricultural seeds, including mixtures, containing more than 20 percent inert matter.
8. Any seed component of a mixture, white clover and *Agrostis* spp. including crop bentgrass and redtop excepted, constituting less than 5 percent by weight cannot be claimed but shall be included under "other crop seed."

**SEED LABORATORY**

Massachusetts Agricultural Experiment Station, Amherst, John Kuzmeski, in charge, Feed, Fertilizer & Seed Control. Wm. N. Rice, Chief Analyst and Director of Seed Lab.

**ENFORCEMENT**

State Department of Agriculture, Commissioner of Agriculture, 100 Cambridge St., Boston 02202. Nathan Chandler, Commissioner of Agriculture; John J. McColligan, Attorney, and James M. Cassidy, in charge of Seed Inspection Service.

**"STOP SALE."** The Commissioner may order any seed found not tagged as provided by law or which does not conform to the label attached withheld from sale until properly tagged or labeled or made to conform to the label. Any person aggrieved by such an order may, within ten days after entry thereof, appeal therefrom by petition to the superior court in the county he resides or has his business or in the county of Suffolk. The court may affirm, modify or revoke such order. Said order shall remain in force until so modified or revoked.

**"SEIZURE."** Any lot of agricultural, vegetable, flower or tree and shrub seed not in compliance with the provisions of this law shall be subject to seizure on complaint of the Commissioner to a court of competent jurisdiction in the area in which the seed is located. If the court finds the seed in violation of the Seed Law and orders the condemnation of such seed, it shall be denatured, processed, destroyed, relabeled, or otherwise disposed of in compliance with the Laws, providing that the court shall not order such disposition of such seed without first having given the claimant an opportunity to apply to the court for the release or permission to process or relabel said seed to bring it into compliance with the Seed Law.

**"TREATED SEED."** Labeling of treated seed will be in accordance with section 201.31a of Rules & Regulations under the Federal Seed Act, latest edition of U.S.D.A. Service and Regulatory Announcements No. 156.

**TOLERANCES** as adopted by the ASSOCIATION OF OFFICIAL SEED ANALYSTS shall be recognized in the administration of the Massachusetts Seed Law.

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