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HOLE NOTES

OFFICIAL PUBLICATION OF THE MINNESOTA GOLF COURSE SUPERINTENDENTS' ASSOCIATION
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SHORT SEASON NEARS END

by KEITH SCOTT, CGCS
MGCSA PRESIDENT

One of the benefits/hardships of working in Minnesota is the short season, the broad range of weather conditions, and the ever increasing amount of play. With the growth of golf and increased number of golf facilities, we see golfers playing a wide variety of courses. As professionals in our business, we cannot view comparisons without acknowledging all of these variables, plus memberships, committees and budgets. Let us continue this growth with constant communication with our golf membership and participation in educational programs.

Our annual Superintendents' Tournament, held at the Edina Country Club, was very successful. We had the opportunity to play one of the most challenging and finest groomed courses in the state. Thanks to host Superintendent Bill Johnson and the Edina Country club staff for hosting the event. Our appreciation to the Cushman Company for their equipment display and to the Brayton organization for supplying the educational portion.

A special note to those superintendents who are not affiliated with the Golf Course Superintendents Association of America. If you become an approved member by December 31, 1989, you are entitled to receive complimentary registration at the 61st GCSAA International Golf Course Conference and Show, February 19-26, 1990 in Orlando, Florida.

Edinburgh U.S.A. will be hosting the annual Harold Stodola Research Scramble, September 25, 1989. This is one of our most popular and successful events. Sign up early and use this opportunity to play with club members.

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MICRONUTRIENTS FOR TURFGRASS MANAGEMENT

by Dr. Roy L. Goss
Extension Agronomist-Emeritus
Washington State University
Puyallup Research and Extension Center

The health and vigor of turfgrasses and their ability to endure stresses are totally dependent upon their environment and management programs. The factors of soils, temperature, limited growing season, rainfall and humidity are few of the environmental concerns. Many factors make up management programs and, although there are close interrelationships between these factors, this discussion will attempt to bring out in some detail the role of micronutrients.

THE SOIL FACTOR:

Any discussion of micronutrients is more meaningful once we have considered the soil factor. Several aspects of the soil factor are briefly discussed as follows:

Texture. Soil texture, being the percentage composition of the components of sand, silt, clay and organic matter, can vary from sand to clay. Clay, organic matter and, to a much lesser extent, silt are the components that determine the cation exchange capacity of a soil. The cation exchange capacity is an expression of the potential of this soil to hold plant nutrients. It is important to remember that only ions with a positive charge are attracted to the exchange complex on clay and organic matter particles. Likewise, it must be noted that most of the micronutrients are cations and are held closely on the exchange complex.

When we compare the ability of sand to hold nutrients as compared to clay, there is no comparison. Basically, sands have little or no cation exchange capacity; hence, no nutrients are held or bound on the exchange complex on the surface of sand particles. Another factor in determining the availability of micronutrients to turfgrass plants is the soil pH factor. Micronutrients are notably more available in the acid ranges than they are in the alkaline ranges (pH over 7.0). Soils with very high pH values can frequently develop micronutrient deficiencies. Although iron is not usually considered as a micronutrient, it is a classic from the standpoint of deficiency symptom where iron is literally bound by the high pH factor and is essentially unavailable to the grass plant.

One other factor worthy of mention with respect to the soil factor is the leaching rate of nutrients with respect to the texture. The leaching rate is considered to be the rapidity with which water can pass through the profile and carry nutrients with it. Obviously, sand particles, being much coarser with much larger spaces between them, will leach or drain significantly faster than heavier soils with fine particle sizes.

Structure. The soil structure is simply the arrangement of the soil particles. When soil structure is destroyed, there are few if any air spaces available and most of the root zone is composed of noncapillary (water containing) pores. Even when structure is not destroyed, the soil is well aggregated, and the drainage rate is normal for that particular textured soil, the drainage rate of sands is significantly higher than that for a heavier soil containing reasonable amounts of clay, silt and organic matter. For this reason, the leaching of nutrients, including micronutrients, would be significantly faster in a sandy soil.

Depth. The depth of the soil becomes the final factor with respect to nutrient storage. Obviously, the greater the depth of profile, the greater the root system that can be developed and explore more area for nutrients including micronutrients.

MICRONUTRIENTS

Any practice or program that severely restricts the root system of the grass plant can significantly influence the uptake of all nutrients including micronutrients. Extremely close mowing induces a very shallow root system thereby restricting the root system to a very shallow profile where nutrients can be removed, although at a slightly lower depth there may be adequate plant nutrients. Even when we are sampling soils for laboratory testing at a depth of 3 inches, this may be an unreliable test since the root zone may be restricted to the upper 1 inch where the nutrients have been removed; whereas there is literally a banquet awaiting the root system at a depth of 3 or 4 inches. Factors other than mowing height that will influence the root system and rooting depth would include soil compaction and poor drainage. When oxygen is restricted to the root zone, there will be little or no root development, which restricts the ability of the plant roots to absorb plant nutrients. Most soils have adequate supplies of these micronutrients since the plant requirements are relatively small; however, certain sandy soils and those with extremely high organic matter levels may be deficient in certain micronutrients.

The modern trend in putting green maintenance includes the use of high quantities of sand. In some instances, the entire root zone up to 12 inches is composed of pure mineral sand with no organic matter amendment. Micronutrient deficiencies can occur on root zones of this nature very readily. It should be pointed out before any discussion of micronutrients also that high levels of many of these micronutrients can become toxic to the grass plant, notably ions such as boron and copper.

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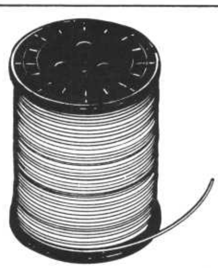

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Visual deficiency symptoms of micronutrients is often misleading and before remedial treatments are begun, the turfgrass manger or golf superintendent should have soil or tissue analyses conducted to verify the presence or absence of micronutrients. For example, a sulfur deficiency can very closely resemble both an iron or nitrogen deficiency symptom.

Boron. Very small amounts of boron are usually found in soils except in arid regions and are required in extremely small amount by grass plants. Boron availability is very limited in alkaline soils but is readily available in acidic soils which may account for its deficiency under highly leached acidic conditions. The function of boron, although not well understood, is more in the meristematic (young growing points) and in leaf tips.

Cooper. Cooper deficiencies are very common in highly alkaline and/or organic soils. Sandy soils can also be deficient in copper since they have little ability to retain this nutrient. Copper is very toxic when it occurs at levels greater than that required for plant growth. Copper is very essential in a number of enzymatic systems within the grass plant and can result in the death of the grass plant if the deficiency is severe.

Molybdenum. Molybdenum is a very important factor in the enzymatic system that functions in the reduction of nitrate. Deficiencies in molybdenum can result in accumulation of nitrate in the plant with impaired protein synthesis and can possibly lead to toxic concentration of nitrates. Molybdenum is required in very small amounts and, unlike a number of other micronutrients, is more available in the alkaline range due to its solubility at these pH values.

Manganese. Manganese is required in very small quantities by the turfgrass plant and its solubility is partially controlled by acidic soil conditions and anaerobic conditions. Due to this very factor, manganese becomes significant in the formation of black layer due to the combinations of sulfide ions and manganese ions which results in a black precipitate. Manganese is very important to the turfgrass plant in chlorophyll synthesis and is involved in a number of other enzymatic systems as well.

Zinc. Zinc is required in small amounts and is associated with a number of enzymatic functions. It is believed to be associated with certain growth hormones and auxins and deficiency can affect leaf development.

Iron. This element is probably the one most deficient in turfgrass management programs. The deficiency is most often associated with insolubility rather than an absence of the element. Iron is most deficient in alkaline soils or those high in manganese, zinc and certain other elements. Iron can also be deficient in soils with extremely high levels of phosphate; therefore, excessive applications of phosphate should be avoided. Other deleterious effects of excessive levels of phosphate, especially with their effect upon Poa annua and seedhead formation, have been noted; hence, phosphate levels should be kept to a minimum plant requirement. Iron is not a constituent of chlorophyll although it is extremely important in the formation of chlorophyll.

Chlorine. Although the role of chlorine is not well understood today, it has been accepted as the last essential micronutrient. There is little information available on the level of chlorine to be supplied, but rarely has there ever been observed any deficiency of chlorine. In general, the chloride ion exists as an impurity in a number of fertilizers; therefore, there are frequent applications of chlorine, generally resulting in no deficiency.

SOIL AND TISSUE ADEQUACY OF MICRONUTRIENTS

It has previously been stated that the availability of micronutrients is strongly regulated by the soil reaction (pH). Only a very few of our nutrients are more commonly available in the alkaline range; hence, we should carefully guard this factor closely. In general, turfgrasses will respond better when the soil pH is in the mildly acid range. In general, the writer has not observed any problems with nutrient availability in bentgrass or Poa annua putting greens with pH values as low as 5.5.

Bentgrasses usually respond very favorably to pH ranges between 5.5 and 7.0. It should be advised, however, that Kentucky bluegrasses perform best at p[H values near 7.0.

It is extremely difficult to find in the literature and in textbooks anyone brave enough to spell out soil values and tissue values for micronutrients in turfgrasses. These factors have been fairly well identified in many of our economic agricultural crop plants, but rarely does any refer to the turfgrass plant.

The author has searched the literature carefully and has come up with what he considers the best range of micronutrients for turfgrass management, both oil levels and tissue levels. Some of these values have been taken from soil testing laboratory handbooks, but the most important factor is that these micronutrients have been "road tested" for a number of years in the Pacific northwest and we feel very comfortable with these values to prevent micronutrient deficiencies. The following table shows these values which can be used as a guide, from my point of view, anywhere in the United States.

TABLE 1. MICRONUTRIENT SOIL AND TISSUE ADEQUACY LEVELS.

Nutrient	Soil level	Tissue level
Boron	1.3-2.0 ppm	9.0 ppm
Copper	1.6-3.0 ppm	17.0 ppm
Molybdenum	0.2-0.4 ppm	5.0 ppm
Manganese	30.0-50.0 ppm	41.0 ppm
Zinc	5.1-8.0 ppm	20-40 ppm
Iron	25.0-50.0 ppm	280 ppm
Chlorine	Unknown	Unknown

Now that we have covered the academics of the subject of micronutrient adequacy for turfgrasses, let's be practical. How does the average golf superintendent or other turfgrass managers determine micronutrient deficiency? Visual symptoms are quite often extremely misleading. We have already mentioned the fact that sulfur deficiency very closely resembles nitrogen deficiency. Possibly phosphate deficiency can sometimes be confused with sulfur deficiency or deficiency of other nutrients. In general, phosphate deficiency is a purpling of the grass tissue and is quite easy to diagnose. But other times it can be somewhat misleading and possibly results in slow growth rate. Deficiencies symptoms of magnesium very close resemble those of calcium and can be confused. Now, let's consider a very practical aspect. What happens when a nutrient availability is such that a deficiency symptom is not distinct, but the growth rate and density of the turf has diminished? In this event, the only practical way to determine the micronutrient deficiency is either by tissue or soil test. The above table will be of value in helping to determine these deficiencies. In taking tissue tests, however, the operator must be extremely careful to collect a good representative sample of the tissue, it must be clean with no soil particles, and the container (basket) in which the clippings are caught must be very clean with no fertilizers apparent and they must be properly handled all the way to the laboratory. Likewise, the same advice is applicable for soil tests. The soil test will also be a good means of determining micronutrient deficiency provided you take into account the soil reaction - whether the soil is acidic or alkaline.

There is no question that on sand profiles micronutrients will be limiting if not supplied. For this reason, we have tried to develop a formulated fertilizer that supplies extremely small amounts of micronutrients with each application and can essentially be used every time a putting green or sand-based sports field is fertilized. This fertilizer formulation has proved very successful for practitioners in the Pacific Northwest for approximately 5 years at this point and we feel it is doing a good job on sand root zones with no deficiencies ever having been observed under this program.

In conclusion, we must keep reminding ourselves that there are 16 nutrients that are required for plant growth, three of these being available from air and water, N, P and K from fertilizers, calcium and magnesium are available from liming materials and sulfur is available from any number of sources including elemental sulfur materials. The other 7 considered to be micronutrients must be supplied in very small amounts where required and on a frequency that the plant does not become deficient.

THE EXTENSION LINE

Bob Mugaas of the University of Minnesota Extension Service is a regular contributor to Hole Hotes. As Hennepin County Extension Agent, Mr. Mugaas compiles various articles related to the golf field for our information. Bob is an excellent source for answers to many questions on horticultural problems. He may be reached at 612/542-1420. Written requests should be sent to:

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Minnesota Extension Service-Hennepin County
701 Decauter Ave. N.
Suite 105
Minneapolis, MN 55427

This month's articles cover Perennials, Oak Wilt, and Purple Loosestrife.

PERENNIALS

by Don Selinger
Plant Materials Committee
Minnesota Nursery and Landscape Association

Perennials that provide us with color throughout the better part of the summer have been gaining rapidly in popularity. In many respects they combine the flowering attributes of annuals with the benefit of not having to replant each year. This is especially true of those that are reliably hardy, relatively maintenance free and will tolerate or thrive under the hot, dry conditions we have been experiencing the last few years.

MOONBEAM COREOPSIS *(C. verticillata 'Moonbeam')*, **PURPLE CONEFLOWER** *(Echinacea purpurea 'Bright Star')* and **BLACK EYED SUSAN** *(RUDBECKIA fulgida 'Goldsturm')* are three that have been gaining in popularity because they do satisfy the criteria mentioned. They can provide a bold display of color by planting them in mass or they are attractive enough to use as individual specimens.

COREOPSIS MOONBEAM forms a very attractive clump with finely textured foliage that is covered in summer with creamy yellow daisy-like flowers. Various cultivars of Coreopsis (Tickseed) have long been used in the perennial garden to provide summer color and as a good source of cut flowers. Most of the cultivars of Coreopsis used as a cut flower possess a deeper golden yellow and have their blooms borne on stems of 18 to 24 inches that are ideal for cutting. While the other cultivars are superior as a cut flower, Moonbeam is unsurpassed for use as a landscape plant. Besides having a paler yellow flower, Moonbeam forms a more compact plant of up to 18 inches with almost fern-like foliage that lends itself to landscape use and makes an attractive plant whether it is in or out of flower. Moonbeam will do well in sun or light shade and in any well drained soil. It is relatively insect and disease free and will tolerate the heat and drought quite well.

PURPLE CONEFLOWER is a member of the sunflower family that is native to much of the eastern United States including Minnesota. Several cultivars are available, with Bright Star being the more common one. Bright Star produces an abundance of blooms of deep rosy-purple with a maroon cone-like center that remains attractive even after the flower fades. The flowers are produced on plants of 2 1/2' to 3' from midsummer until frost. In addition to making an attractive landscape plant it can also be used as a cut flower, either fresh or dried. Being a native of prairie conditions Purple Coneflower will withstand heat and drought extremely well and does not have any serious insect or disease problems. It does require full sun and will do well in most any well-drained soil.

BLACK EYED SUSAN *(Rudbeckia)* is a very common native of the prairie in a good part of the United States. The cultivar Goldtrurm was selected for the deep yellow flowers, up to 3 to 4 inches in diameter, that are set off by a deep bronze black cone in the center. The flowers, which are also good for cutting, are produced freely during August and September on an attractive plant of 2 to 2-1/2 feet. It will also withstand the heat and dry conditions that are common to the prairie and does best in full sun to light shade. Insects and diseases are generally not a problem.

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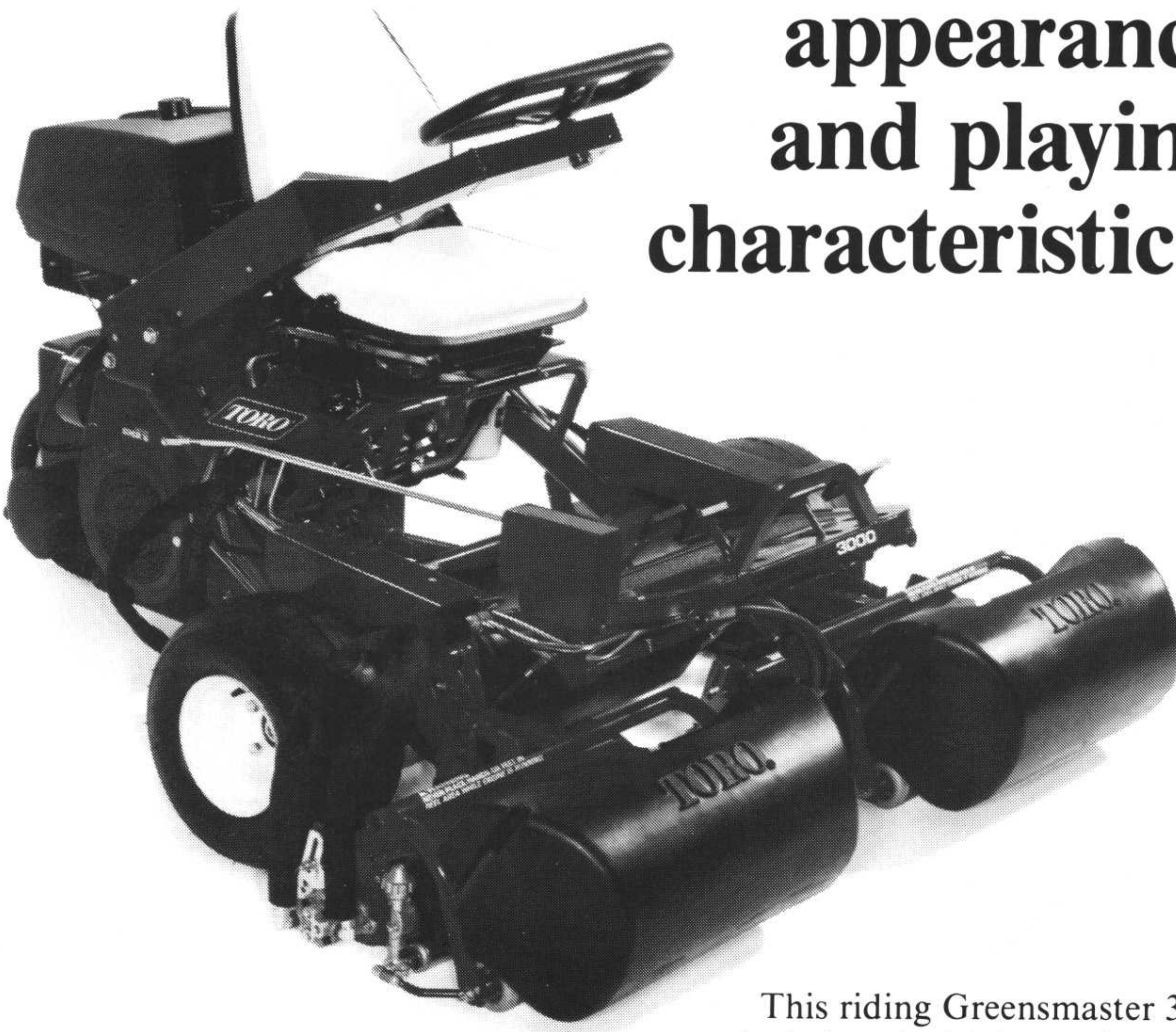

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