MANAGING TURF GROWING ON SUBSOIL

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The successful turf manager recognizes there are many factors which impact on the management decisions necessary to provide a quality, stress tolerant turf. One of these is soil conditions. All too often in Michigan, soil conditions are significantly limiting. Under such conditions the management inputs needed to attain a quality turf are increased. A prime example is home lawns and other grounds where the soil on which the turf is growing consists of subsoil.

On a given site the best soil available is normally the topsoil, that layer on the surface which has the most organic matter and the best soil structure for growing plants. Unfortunately, in Michigan the topsoils are often rather shallow. Developers may salvage what topsoil is present on a site for use for lawns and landscapes. Or they may sell the topsoil to someone else for use on another site. In other cases, in the process of moving soil around on the site, topsoil gets mixed with subsoil or is buried by subsoil. The result is that a high percentage of lawns for new homes and residential and commercial developments are established on subsoil.

A further problem can be that turf establishment responsibilities go to the lowest bidder. In many cases, the lowest bid does not include proper soil preparation for the turf. If good soil preparation is proposed the cost will be higher, usually causing the landscaper to submit a bid high enough so the contract is lost. The problem seems to be of greater concern with sodding because the landscaper can lay sod on compacted subsoil with an appearance of the turf being in good condition. If turf is established by seeding, better soil preparation will usually be necessary.

It should be pointed out that most landscapers are preparing soil as well as they can considering budgetary constraints. Landscapers might consider submitting two budgets to their clients for turf establishment. One could be the competitive, low bid; the second could be based on improvement of the soil which would obviously have a higher cost and would need to be sold on that basis.

When dealing with soil problems, there are three aspects of soil management to consider: physical, chemical and biological. Physical soil problems include compaction, poor drainage, layers and low water holding capacity. Soils with high sand content in the subsoil hold little available water, resulting in turf which is highly susceptible to moisture stress and related problems.

Physical soil problems

Subsoils which contain much silt and clay are highly susceptible to compaction. In fact, such subsoils are usually quite compacted as they naturally exist. When developers move these soils while they are wet, further compaction often occurs making the problem even more severe. Compacted soils are limited in the amount of large pores (macropores) necessary for infiltration, percolation, gas exchange (aeration) and easy rooting. An example is the low infiltration of irrigation or rainfall on berms (often constructed with subsoil) which are so popular with landscape architects. In order to sufficiently water the berms to prevent serious moisture stress, adjacent flat areas often become waterlogged.

Compacted soils have high soil strength which will restrict roots and provide a harder surface. Roots of turfgrasses tend to be shallow in compacted soils and may be lower in number than in uncompacted soils. Typically, thatch accumulates faster on compacted soil. Roots grow where there is the least resistance to their penetration through the growing medium. This problem has been particularly apparent on sites where sod growing on compacted subsoils have been over-watered. Soils with high soil strength also provide a harder surface for athletes and others using the site.

Turf density is usually lower on compacted soils, providing more opportunity for weeds to get established. Weedy species which take advantage of compacted sites include knotweed, crabgrass and annual bluegrass. Compacted soils with low turf density will be more subject to variation in soil temperature, especially with higher soil temperatures in the summer, a disadvantage for cool season grasses.

When poor drainage conditions exist, the soil will remain wet for longer periods making the soil more susceptible to compaction from traffic. This means the turf will have lower traffic and stress tolerance. And weedy species will invade easily.

When layers exist in the soil there can be an interruption of drainage (perched water table), causing a number of problems. This can occur when a finer-textured layer underlies a sandier layer, restricting the rate of water movement through the soil. Another way in which this occurs is when a finer-textured layer is placed over a sandier soil. This happens when sod grown on soils high in clay content is laid on sandy soils. This problem has been evident on some athletic fields which have had sloppy surfaces in spite of the sandy soil below. When sodding sites which will be subject to heavy traffic, the sod should be grown on soil which is as sandy or sandier than the soil on which it is to be placed. Thatch layers covered by soil layers can also result in this perched water table phenomenon.

Chemical Soil Problems

Most subsoils in Michigan have Ph values above 7.0. The presence of free calcium carbonate causes the Ph to range up to 8.3. While this high Ph can reduce availability of nutrients, particularly the micronutrients iron and manganese, to our knowledge there have been no problems with such deficiencies on turf in Michigan. The calcium and magnesium soil tests will be very high in such soils, especially those high in clay content.

Subsoils have little organic matter. As a result they will be very low in native content of nitrogen and phosphorus. Potassium may be very low as well. Sulfur content will be low. And iron, manganese, copper and zinc are typically low in subsoils. While all of these nutrients may be naturally low is subsoils the most important nutrients from a turf management perspective on these soils are nitrogen, phosphorus and to some degree, potash.

If soils high in silt and clay are subjected to soluble salts and sodium, because of slow drainage and high cation exchange capacity the leaching of these salts will be very slow. The effects of the salts and sodium will last much longer. This is most likely to occur where deicing salts are utilized.

While the black layer condition has been most commonly observed in greens with sandy soils, this condition can also be found in finer-textured soils.

In addition to low water holding capacity in sandy subsoils, low cation exchange capacity creates increased management concerns. The combination of low water holding capacity and low cation exchange capacity result in ready leaching in sands.

Biological soil limitations

Biological soil limitations in subsoils include poor rooting, low microbial activity and limited macrobiological activity. Microorganisms are particularly active in the zone adjacent to roots. Exudates from the roots provide a ready source of food for the microbes. Subsoils, being low in organic matter do not have adequate food sources for large microbial populations. In addition, subsoils have fewer earthworms and other macroorganisms. Encouraging earthworm activity can be very helpful in improving physical and biological conditions in soils.

MANAGING TURF ON SUBSOILS

There are a number of matters to consider when determining how to manage turf growing on subsoils. If possible, subsoils should be modified before turf establishment. In most cases, however, the turf manager must work with turf already established on such soils. Most of the roots of cool season grasses will be in the top 4 inches of soil. As a result, it is best to have a uniform soil layer of at least 4 inches whether accomplished with natural soil or by modifying a subsoil.

1. Modify the soil before turf establishment. The more intensively a turf is used or the higher the quality of turf desired, the deeper should be the soil. For minimal use conditions, a minimum of 4 inches of uniform soil is desired with more being a better situation, of course. If only 2 inches of topsoil fits the budget, for example, this should be tilled in to a total depth of at least 4 inches. To increase the water holding capacity and cation exchange capacity of sandy soils, topsoil or peat can be mixed with the sand. Again, till as much as can be afforded into a 4 inch depth. If enough topsoil is available, at least 4 inches can be used on a site. For best results with athletic fields and other intensively used turfs, the minimum depth of uniform soil should be at least 8 inches, and preferably more.

2. When establishing turf by seeding or sodding, mix fertilizer and lime into the soil. The deeper one can till in the fertilizer, the better, but a minimum of 2 inches is preferred.

3. For established turf sites which have a compacted soil condition an aggressive cultivation program is essential to relieve that compaction. The aerifiers which can effectively loosen the soil are usually the most expensive as well, which may not fit the budget for some turf managers. An example is in the lawn care industry. Some of the aerifiers which can maneuver in small areas do not permit penetration deep enough into the soil or do not loosen the soil well. Although there are many things to consider, we suggest using an aerifier which creates a hole about every 3 inches and penetrates at least 2 inches into the soil. If the aerifier has a wide spacing between tines, it is a simple matter to make sufficient passes over the area to create the desired density of holes in the turf. As a general rule the higher the energy with which the tines hit the soil, the greater the loosening effect on the soil.

   Soil conditions at the time of cultivation have a significant impact on how effectively an aerifier works. When soil is highly compacted or is very dry, some aerifiers will not penetrate deeply enough. It may be necessary to wait until the soil moisture is higher or add extra weight to the aerifier, if possible. The soil should not be saturated or too wet. Any traffic (including cultivation) when the soil is too wet can result in greater compaction.

4. If there is a serious thatch problem on the site, one should under take a thatch control program. For effective thatch control, there are several management practices to consider. First, adjust any management practices which could contribute to thatch accumulation. A prime example is irrigation practices. A common problem observed on compacted subsoils which are watered with an automatic irrigation system is over–watering. Over time this can result a in deep thatch. Applying the amount of water to provide the needs of the turf for the day (or other watering

interval) should reduce the tendency for thatch to accumulate. One can use the daily watering program proposed by Dr. Joe Vargas in a thatch control program. In his research he found less thatch on plots watered daily compared to those watered less frequently. The key to successful thatch control with the irrigation program is to apply no more water than the turf needs.

Other management practices which can provide thatch control include cultivation, dethatching (verticutting on greens and other closely mowed turfs) and topdressing. For home lawns and other general grounds, cultivation is the most effective tool for achieving thatch control. Bringing soil to the surface with cultivation allows mixing that soil into the thatch layer, thus giving thatch control. In our research we have not seen a reduction in the amount of organic matter (thatch) in plots which have been aerified, but we have observed that the thatch is mixed with soil so there is not a distinct layer of each. Thus we refer to this as thatch control, not thatch removal. The key to successful cultivation for thatch control is aerifying at the proper frequency and bringing enough soil to the surface so the desired level of mixing occurs. This will vary from 2 or 3 cultivations per year for turfs which have high rates of thatch accumulation to once a year for most turfs. Some turfs have no thatch or compaction problems and need no cultivation, of course.

Dethatching can also be used in a thatch control program although this alone may not adequately control thatch on some sites. Timing of dethatching is important. Most home lawns are dethatched in the spring. While this is effective, dethatching is often done at a time when warm, stressful weather follows. If the turf is injured sufficiently by dethatching followed by temperature and/or moisture stress, the cool season grass can be thinned even more. If conditions are conducive, crabgrass or other weeds can then get established in the open turf. If dethatching can be done in the fall, there is greater potential for quick turf recovery as well as less weed encroachment.

It is clear that dethatching and cultivation should be done at a time when the turf is growing actively for good recovery from any injury caused by these practices.

Topdressing can be used very effectively in thatch control but is practiced almost exclusively on golf courses with some application on athletic fields. On other turfs it is not practical to use topdressing because of the difficulty in applying the topdressing uniformly.

5. When soils are susceptible to compaction, it is best if traffic can be controlled. This is seldom possible, but one can use a combination of changing traffic patterns as well as traffic when the soil is wet in order to reduce compaction.

6. Since subsoils are normally low in the fertilizer nutrients, higher rates of N, P and K should be mixed into the soil at time of establishment or applied to existing turf. Subsoils are especially low in P. We have observed several cases where no or little P was applied at establishment. Then no P was applied by the lawn care company fertilizing the sites. Clippings were removed. All these practices have resulted in P deficiencies resulting in grass that grows very slowly and has a purplish–dark green appearance.

   Turfs on subsoils will require more N to attain the same quality of turf compared to those on topsoils. This may be true for several years until some organic matter can be built up in the soil. It is also possible that more denitrification could occur on compacted subsoils if the turf is over–watered. This, too would increase the need for additional N.

   Although we have little information on other nutrients needed for turf growing on subsoils, one could use a fertilizer which contains a little of each of the micronutrients as well. There is no guarantee this will provide a meaningful response, however.

7. Soil testing for pH, P and K is especially helpful on soils low in these nutrients. This is necessary to determine if any of these nutrients is deficient and what amounts are needed to provide quality, stress tolerant turf. If P is applied on turfs with a thatch layer of an inch or more, the P could get hung up in the thatch layer. While the turf can still take up the P from the thatch layer, the P will

not likely show up in the soil below. The P test in the thatch layer will probably be high as we have seen on research plots. Soil tests for K will respond similarly.

8. The question of adjusting soil pH is often raised for turf growing on subsoils. If the soil is acid, liming should definitely be done on the basis of soil testing. However, if the pH is high (over 7.6 or so) should a program for reducing pH be considered? For cool season grasses in Michigan, it is not recommended to try to acidify the soil. It is difficult to apply the appropriate rates of acidifying agent without causing injury to the grass because the pH of the thatch or top layer of soil can become too acid. Since there does not appear to be a turf problem when the pH is high, there is no need to change pH. However, if there are acid loving landscape plants which need an acid soil, an acidification program is justified under those conditions.

9. Although the topic has been mentioned already, proper irrigation is such a key management practice on subsoils it is worth stressing as a separate topic. Since rooting may be shallow in compacted soils, it is important to consider how much available water is held in the rootzone for the turf. If the roots are only 2 or 3 inches deep, there is no need to irrigate soil to provide wetting below that depth. Use of a soil probe and careful observation will help one to determine the appropriate amount of water to apply to a turf. Pay attention to how the root depth changes with season. Often the roots will be deepest in late spring and shallowest in late summer. If grubs have been feeding on roots, the turf should be watered lightly and frequently until adequate root depth has regrown.

10. The question has been raised as to whether the use of organic amendments and fertilizers will improve subsoils. Certainly, if adequate organic amendments can be worked into the soil at establishment, this can improve physical, chemical and biological properties. This is encouraged. Peats and other organic sources can be mixed into the soil. What about the use of organic fertilizers? Although there is little data available on the subject, it seems appropriate that regular use of natural organic fertilizers should encourage more biological activity, including earthworms. Until there is scientific evidence to prove otherwise, the use of organic-based fertilizers is suggested for turfs growing on subsoils.

    The soil and turf conditions will vary from site to site, so the most effective of the practices mentioned above will be dependent upon on-site evaluations. The turf manager responsible for the turf must determine the most limiting factors and make appropriate management adjustments for the site within the limits of budget. Improving the physical, chemical and biological properties of subsoils will make turf management easier.