UNDERSTANDING TURF MANAGEMENT
The fifteenth in a series
by R.W. Sheard, P.Ag.

MOWING

The mowing of turf is a complex issue involving the interaction of height, frequency, mowing equipment, species, stress and turf use.

Mowing height and frequency requires a balance between beneficial and adverse effects. Mowing increases turf quality through better tillering, thus providing more shoots per unit of ground area. On the other hand, mowing decreases root growth due to the removal of leaf blades which in turn reduces photosynthesis. Mowing decreases tolerance to stress including wear from play, drought, high and low temperatures, disease and weed competition.

A knowledge of the location of the growing point or meristematic region is essential in the understanding of the physiology associated with mowing of turf grasses. The meristematic region is that section of the plant where active cell division occurs. In dicots (a plant group to which many weeds belong) the growing point associated with stem elongation is located at the tip of the plant so that the youngest leaves are at the top of the stem. In the monocots (the group to which turf grasses belong) the growing point seldom moves above the soil surface, except where seed head formation occurs. New leaves are continually produced by lateral bud development around the growing point and each individual leaf elongates by cell division in a region at the base of the leaf, know as an intercalary meristem. As these cells enlarge and mature the leaf elongate. Thus the mower is cutting of the oldest part of the leaf while new leaf tissue is being formed at the base (Figure 1).

The intercalary meristem of an individual leaf remains active in cell division for only a short time (weeks) so that by the time the leaf becomes visible most active cell division has ceased. Cell enlargement or growth of each cell continues, however, forcing the sheath and the leaf higher, requiring the cutting of the turf. Mowing so close to the soil surface as to damage the intercalary meristematic region results in what is called scalping and death of the plant.

The repetitive removal of the top of a grass plant disrupts the normal procedure for the seasonal development of the plant. Normally, at the commencement of spring growth, one or more of the principle tillers existing at the base of the plant begins a process of internode elongation, elevating the growing point above the soil surface. Elongation of the stem is designed to elevate the seed head above the leaf canopy to promote flowering, pollination and seed dispersal. Under most turf conditions, with the exception of annual bluegrass and some cultivars of bluegrass and ryegrass, stem elongation never occurs and the plant remains in an unnatural vegetative condition throughout the season; in other words during a major part of the year it is under a stress of forced vegetative reproduction. Turf grasses, however, have developed varying degrees of tolerance to repeated removal of top growth as pasture grasses have developed varying degrees of tolerance to repeated close grazing.

Vegetative reproduction is a desirable means by which the density of the stand is increased by tiller development from lateral buds at the base of each tiller. Both mowing height and frequency have an impact on the degree of tillering that is obtained. Mowing, in removal of the older part of the leaf, removes the section responsible for hormone production which suppresses tiller development. Furthermore, the amount of tillering induced by mowing will be greater during those periods of the year when the plant would not normally be attempting seed production - fall and very early spring.

Increasing the mowing height will obviously increases the amount of the plant remaining above the soil surface (Table 1). Increasing the amount of material re-

Fig. 1: A schematic representation of the meristematic regions in a turfgrass tiller from which new growth originates.

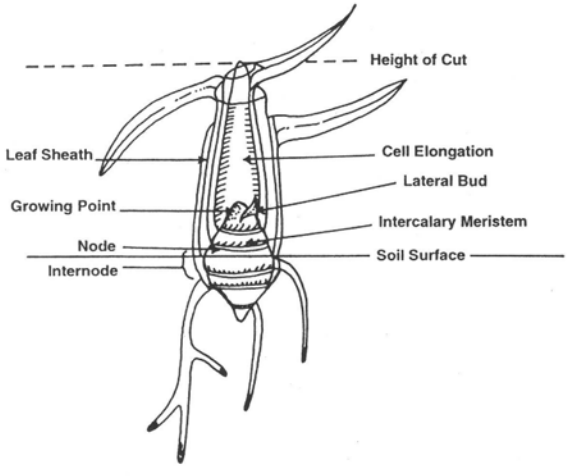


Table 1: The weight of green material (verdure) remaining following mowing Kentucky bluegrass at several heights.

Height of Cut	Gram Fresh Weight/ 10 m^2
(in)	(g)
0.3	1.5
0.5	2.5
0.75	12.5
1.5	20.5
2.5	27.5

(From: Madison, J.H. 'Practical Turfgrass Management' Van Nostrand Reinhold Co., Toronto)

Table 2: The influence of mowing height and moisture content on the impact resistance (hardness) of bluegrass on a sandy loam soil.*

Mowing Height	Moisture Content Wet	Dry
(cm)	(meters/sec^2)	
3	497	773
9	518	740
15	529	720

*From Zebarth, B. (1984) M.Sc. Thesis, Univ. of Guelph.

Table 3: The relationship of mowing height to soil temperature in a Kentucky bluegrass turf.

Height of Cut	Soil Temp. @ 1 .0 Inch
(inches)	(°F)
0.75	93
1.0	90
1.5	83

(Note: Air temp. 5 ft. above turf = 98 °F; Turf surface temp. = 109 °F)

Table 4: The relationship of mowing height to water use by turf-type tall fescue.

Height of Cut	Evapotranspiration
(inches)	(inches/day)
0.75	0.25
1.5	0.33
3.0	0.50

(Note: Measurements made under Nebraska conditions in June)

maining after mowing would be expected to enhance the resiliency or cushion for the athlete on a sports field. Impact resistance studies, however, have demonstrated that the amount of vegetation has only minor effects on surface hardness relative to that of increasing the moisture content of the soil (Table 2). On the other hand, increasing the verdure may limit ball bounce and distance of ball roll in many sports.

The well being of the turf, within limits, requires the higher cutting heights for increased photosynthetic activity, greater root and rhizome growth, greater weed control and less susceptibility to disease. Eliot Roberts of The Lawn Institute calculates each 1/8 inch increase in cutting height of bluegrass adds 375 ft^2 of leaf surface area per 1,000 ft^2 of turf surface.

Raising the mowing height also reduces the soil temperature, reducing heat stress (Table 3), but at the same time increases the water use of the grass (Table 4).

Even a well-managed turf may be seriously damaged when mowed following a delay in cutting due to a protracted wet spell. Raising the height of cut, followed by a step-wise lowering to the original height can reduce the damage caused by the removal of an excessive amount of leaf material and smothering due to bunching of clippings.

Frequency of mowing is determined by how much leaf material is desirable to remove at any one time. A general rule of thumb is that not more than 1/4 to 1/3 of the leaf blade should be removed at any mowing. The less material removed, the lower the 'shock' effect on the plant. The 'shock' is the mowing effect on decreasing the rate of root elongation and tiller bud development. Since root elongation has an important role in water uptake by the turf the 'shock' effect of excessive removal of tissue will intensify water stress during periods of drought.

Mowing height and frequency depends on the species and use of the turf. Bentgrass on a bowling green requires daily mowing at 1/4 inch. In contrast bluegrass on a soccer field may require mowing at 2.5 inches every 3 days in early May whereas in August weekly mowing will suffice.

The mowers used in cutting turf are of three principal types - reel, rotary and flail.

Reel mowers are used for precise cutting and particulary at low cutting heights such as on bowling greens where the roll of the ball is vital. A disadvantage of a reel mower is the tendency to leave unsightly seed stems which are pushed down ahead of the reel. A reel mower cannot effectively mow grass shoots or weeds that are higher than the height of cut plus the radius of the reel. Thus a 6-inch diameter reel set to cut at 2 inches will not mow 5-inch high grass, except under very dry conditions and will not clean-cut grass over three inches tall.

Rotary mowers are used for general cutting and when properly set will provide a uniform surface. At heights over five inches sufficient 'suck' to lift the grass blades upright for an even cut can be a problem. Uncut, laid over grass in the tractor wheel marks can be unsightly and damaged the turf through smothering. They are less expensive to maintain than reel mowers. Both reel and rotary mowers may show a wavy appearance following mowing if excessive speed is used.

Flail mowers are best used for rough cutting or vegetation control. Cutting heights of over six inches may be used and debris in the grass is not as damaging to the machine.

Sharpness is the prime consideration in the maintenance of all the types of mowers. Dull mowers leave a bruised and frayed leaf tip which turns an unsightly grey to brown within a couple of days. Ryegrass, in particular, requires a sharp mower because of the tough vascular bundles in the leaf. The cut end, with its organic exudates (bleeding), is an excellent portal of entry for pathogens, thus clean, surgical cut is most desirable.

Mowing is a daily decision of the turf manager. A fixed mowing schedule may be administratively desirable, but the health of the turf is decided by daily, on-site assessment of the need for mowing of each field and the height of cut to be used.

Red Thread Disease Control

Tom Hsiang

Red thread disease is found in temperate regions throughout the world. Red thread is caused by the fungus *Laetisaria fuciformis*, but other fungi such as *Liminomyces roseipellis* can cause similar symptoms. The causal agent was identified in Ontario as *L. fuciformis* by the presence of antler-like red threads and the absence of clamp connections.

Red thread most frequently develops on perennial ryegrass and red fescue, particularly under low nitrogen conditions. It is also found on Kentucky bluegrass. It causes circular patches (5 - 50 cm in diam.) in which infected leaf tissue appears water-soaked, die and bleach out. The straw-coloured leaves among the live green leaves gives the turf a ragged appearance. The patches may be scattered or close together, and may be confused with dollarspot.

In Canada, red thread is most commonly seen in the wet maritime climate of coastal B.C. However, heavy levels of red thread infection were seen in the summer of 1992 in southern Ontario due to the extremely wet and cool conditions. This was atypical for southern Ontario which usually experiences red thread symptoms (if at all) in mid-fall. An increased incidence of red thread was again observed in 1993. The beginning of the 1993 growing season was extremely wet and cool, and thus provided much better conditions for red thread disease than normally encountered. The red thread infections persisted throughout the latter half of the summer of 1993, even though it was much warmer and drier.

Prof. Hsiang selected a 3-year-old stand of perennial ryegrass which was observed to have high levels of natural infection in late spring and which persisted into summer. Eight fungicide treatments were foliar applied on Aug. 12, 1993, and were reapplied on a 7-day, and 14-day schedule over a five week period. Turfgrass cultural treatments were similar to those used for maintenance of sports fields in Ontario. Ten percent infection of the plot was considered an acceptable level of the disease and was used as the criterion for efficacious control of red thread.

Estimations of the area affected by red thread on 1 by 2 m plots were made at six dates between Aug. 12 and Sept. 15, 1993 (Table 1). By the second week after spraying, all fungicide treatments showed a general decrease in disease with Daconil 2787, Fluazinam and Fore being the most effective materials. By the fourth week all the remaining treatments showed significant reductions in infection relative to the control. In general aesthetically acceptable levels of the disease (less than 10% of the area showing infection) were achieved three to four weeks after the initial application.

There are no fungicides registered for the control of red thread in Canada.

Fortunately in southern Ontario, cultural management practices are usually sufficient to contain the disease. Moderate levels of nitrogen are usually able to contain or mask the infections. In the U.S. the disease has been shown on well-fertilized turf, and is thought to be increasing in severity and distribution.

Table 1: The area of turf affected by red thread as influenced by material, application rate and spray schedule.

			Date of Evaluation of Area Affected					
Material	**Rate**	Interval	8/12	8/20	8/25	9/4	9/9	9/15
	(prod./100 m^2)	(days)				(%)		
Banner 130 EC	31 mL	14	29	24	19	14	6	8
	62 mL	14	24	14	13	8	6	8
Daconil 2787	90 mL	7	30	26	12	10	4	4
Dyrene 4	162 g	14	28	21	20	16	8	9
Fluazinam	15 mL	14	26	18	11	4	1	6
Fore	400 g	7	21	11	10	4	7	2
Nova	20 g	14	23	18	15	5	5	8
Rovral Green	60 mL	14	28	15	16	4	4	8
Tersan 1991	30 g	14	28	28	19	19	8	8
Untreated	-	-	26	24	24	2	24	23

Pricing Nitrogen Fertilizer

R.W. Sheard, P.Ag.

Does a visit from your fertilizer sales person often leave you bewildered? What are the questions you should be asking yourself as you listen to the sales pitch?

- Should I use organics or inorganics?
- Should I use slow release or solubles?
- Should the nitrogen be as a nitrogen only carrier or a mixed fertilizer?
- What time and rate of application should I use?
- What analysis should I buy?
- What price should I pay?

An article could be written on each factor. Each is important. With today's budget restrictions, however, price often overrides the other factors. How should one go about making a price comparison of the various materials that are available today? In the final analysis it is the price which most often dictates the sale.

A fertilizer generally consists of one or more of the three major nutrients - nitrogen, phosphorus and potassium. However, in the production of turf the principle reason for purchasing fertilizer is to supply the turf with nitrogen. In many, many cases, if the turf manager has a soil test for phosphorus and potassium he will find, for most applications, that he only needs a nitrogen fertilizer.

How does one compare nitrogen carriers on the basis of price? It is totally erroneous to compare carriers on the basis of cost per tonne. Such a comparison is analogous to the proverbial comparison of apples and oranges. They are both round, yet even their skins are different. In a comparisons of nitrogen carriers they all contain nitrogen, but that nitrogen may be in a different chemical form, may be slow release, may have a high potential for foliar burn, etc. Furthermore a comparison on the basis of price per tonne can be erroneous because of the different nitrogen analysis of the various carriers.

The most precise way to compare the cost of nitrogen carriers is to calculate the *price per unit of nitrogen* (cents/kg N) in the carrier.

An example calculation for a 30-0-0 material valued at $300.00/tonne is:

$$\frac{\$300.00}{\text{tonne } 30\text{–}0\text{–}0} \times \frac{\text{tonne}}{1000\,\text{kg}} \times \frac{100\%\ 30\text{–}0\text{–}0}{30\%\ \text{N}} \times \frac{100\ \text{cents}}{\$} = 100\ ^{\text{cents}}/_{\text{kg}}\ \text{N}$$

This calculation, which at first appears daunting and time consuming, may be simplified and use for any material by multiplying the price/tonne in dollars by 10 and dividing the product by the percent nitrogen in the material, i.e.:

$$\frac{300 \times 10}{30} = 100^{\text{cents}}/_{\text{kg}}\ \text{N}.$$

An even more simple rule is to move the decimal point in the price one position to the right and divide by the percent nitrogen in the carrier.

What could be simpler!

Table 1 provides a comparison of some commonly used materials for turf fertilization based on November, 1994, prices. The data illustrate that urea is the cheapest form of nitrogen available, followed by ammonium nitrate. Note that while urea costs more per tonne it is actually cheaper per kilogram of nitrogen; due to the higher analysis.

As one moves into the slow release forms there are dramatic increases in the cost of each kilogram of nitrogen. The more complex the chemistry of the manufacturing process the higher the cost of the nitrogen.

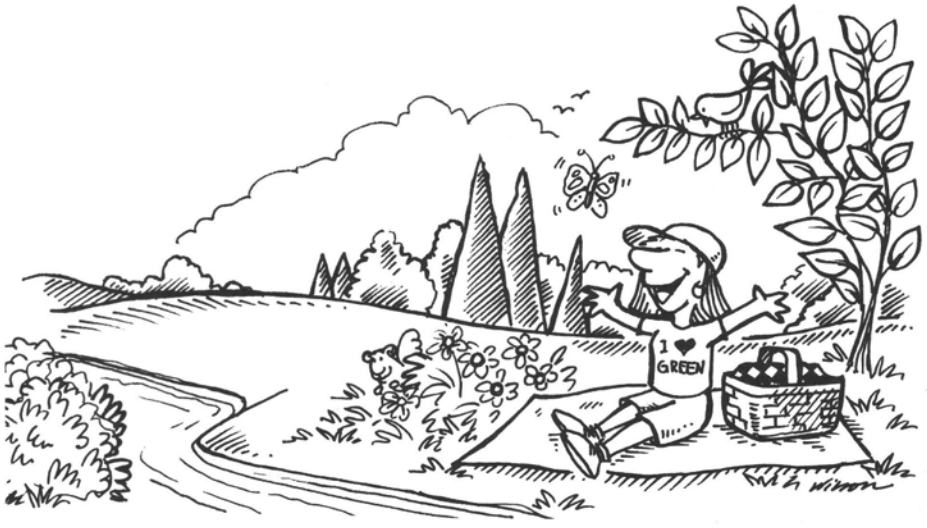
If a comparison is made between two organic sources, I.B.D.U. and Turkey Litter on the basis of price per tonne the Turkey Litter would win. Placing the comparison of the carriers on the basis of price per kilogram of nitrogen leaves I.B.D.U. the winner by three times.

There are many situations where low use turf only needs a yearly shot of nitrogen. A farm grade material may be the answer. Using the price comparisons in Table 1 it would be $0.55 cheaper per 100 m^2 to apply one kilogram of nitrogen as 20-10-15 than to use sulphur coated urea; while at the same time you would be applying 1/2 kilogram of phosphate and 3/4 kilogram of potassium for free. With today's technology it is possible to produce high quality turf by apply 1/2 kilogram of nitrogen/100 m^2 as urea with a pneumatic (air-flow) spreader followed immediately by a light irrigation. Do you have the equipment and manpower to take advantage of the low cost urea or must you substitute the more expensive materials? A accurate knowledge of what they are costing relative to the cost of urea aids you in making the decision.

Table 1: A comparison of some nitrogen sources on the basis of the cost per tonne and the cost per kilogram of nitrogen.

Carrier	Analysis	$/tonne	cents/ Kg N
Ammonium Nitrate	34-0-0	305.00	89.7
Urea	45-0-0	330.00	73.3
Sulphur Coated Urea	32-0-0	600.00	187.5
I.B.D.U.	31-0-0	1700.00	548.4
Organic (Turkey Litter)	5-2-4	856.80	1713.6
Farm Grade Mixed	20-10-15	264.00	132.0

Psychological & Physiological Benefits of Greenspace



Richard J. Hull
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Growing evidence underscores the positive benefits to the mind and body offered by golf courses and similar landscapes

It is often considered that turf and ornamental plantings have great aesthetic value but are fundamentally frivolous and of little real importance. In fact, the U.S. Department of Agriculture clearly views research on turfgrasses and ornamentals as far less important to human welfare than studies on plant foods' fibre or wood. And during times of severe economic constraints, many believe it is more important to design and build for functional efficiency than for landscape aesthetics.

Even those professionally committed to the culture and management of turf and ornamentals would probably not disagree strongly with such statements. It is only natural that we place great value on those elements in our environment on which our survival depends and relegate all else to secondary importance.

In this presentation, I will discuss evidence that these attitudes are at best naive and shortsighted and at worse dehumanizing and dangerous.

The physical decay of our inner cities has been an ongoing problem for decades. While the core of any cities has been revitalized with the construction of civic and convention centres, hotels, shopping malls and other examples of urban renewal, there often remains an expanding zone of neglect and poverty between this core and the suburbs. In this zone crime and violence may be commonplace and, while police have become more aggressive and residents more defensive, the level of violence continues to increase and become more pervasive.

Perhaps it is time to consider the environmental conditions that may promote hostility and anti-social behaviour. This is not meant to minimize the negative impacts of chronic unemployment, drug addiction, broken homes and general feeling of hopelessness that pervade many inter-city communities. Nevertheless, many urban problems may come down to a simple question: Are our attitudes, and behaviours resulting from them, influenced by the physical environment in which we live and work? If they are, the role of the environment in human society can be established and given its true value.

Environmental Preference

Is there any evidence to support the idea that surroundings influence individuals' outlook on life, sense of wellbeing and ultimately their attitude and behaviour towards others? The answer to this question is not easily obtained, but discussion of it may begin simply as a matter of preference.

When given a choice, people prefer or respond more favourably to some environments than they do to others. In this context, environment refers to types of landscapes, or more generally, physical surroundings. This preference for certain surroundings has been the subject of much research conducted by environmental psychologists.

As reviewed by one team of researchers, this research most often involves showing subjects a series of photographic images depicting landscapes of different compositions, complexities and orders. These images may concentrate on natural scenes, those containing primarily man-made structures or a blend of the two.

Viewers are asked to rate each scene on a preference scale of 1 to 5, though the photographs are usually observed for only a few seconds to gauge instinctive reactions. The results of such ratings are subjected to statistical analysis from which patterns of preference can be detected and the elements contributing to preference identified.

In general, people from different socio-economic levels in several countries expressed preference for landscapes of moderately structured complexity exhibiting unobstructed depth and deflected vista that suggested there was more to be seen just around the corner or over the horizon.

In a follow-up report, one researcher illustrated a scene of high preference that appears to be a park or a view down a golf course fairway. Features that contribute to high-preference landscapes include unobstructed visibility, a smooth ground surface that invites movement and a curved line of attention that introduces an element of mystery by suggesting there is more to be learned by entering the scene and moving forward. The presence of a water feature often increases viewer preference. Clearly the landscape provided by a golf course are among the types highly preferred in these studies.

Preference for a landscape or environment exerts a greater influence on human

psychology than a mere like or dislike for a picture. Because like or dislike for the environment is an ever-present stimulus, it can profoundly influence one's outlook and attitude - positively or negatively.

This was effectively demonstrated by a researcher who distributed a questionnaire to residents of nine housing projects in Ann Arbor, Mich. The projects ranged in size from 10 to 55 acres and from 167 to 600 units. The response rate was 33 percent, which generated 268 returns suitable for analysis.

One component of the survey was a photo questionnaire, in which residents were asked to rate a variety of scenes that were similar to those typically viewed from an urban apartment. Not surprisingly, views of parking lots and city street were least preferred, while large expanses of open lawn areas ranked somewhat better. The introduction of trees and landscaping features added considerably to the degree of preference, and views of natural areas that contained the elements of openness and mystery discussed previously received the highest ratings.

The second section of the survey provided particularly significant data. Residents were asked to rate the views from their apartment as they did the photos in the initial portion of the survey. This was followed by a number of questions that attempted to determine the residents' degree of satisfaction with their living conditions, their sense of well-being and their community involvement.

In general, less preferred views (parking lots, city streets and playgrounds) correlated with reduced neighbourhood satisfaction. Views of woods and landscaping, on the other hand, related to much stronger neighbourhood satisfaction and a greater sense of community as expressed in a perception of friendliness and positive relations between neighbours.

A high numerical response to the simple question, "About how many trees would you say are very near your home?" showed the same pattern of satisfaction as questions relating to a preferred apartment view. The perceived availability of nature and open spaces also correlated positively with neighbourhood satisfaction. Even if not visible from an apartment, the knowledge that "natural areas" and "good places for taking walks" were nearby promoted a greater level of satisfaction and connectedness with their neighbourhood.

A Preference for Nature

These findings should come as no great surprise. After all, home owners pay premium prices for lots that afford a desirable view. A preferred view is normally defined as one of natural areas or of designed landscapes that posses those features identified as favoured in the preference studies.

Lots in a suburban development adjacent to a golf course are often the most highly prized - especially if a water feature is included. Conversely, views of a neighbour's backyard or an urban landscape devoid of natural elements add little to real estate values. The billions of dollars spent each year on lawn and garden supplies and services attest to the value most of us place on the natural elements in our home environment.

Most of us have a preference for nature even though we may not be aware of it. Visualize two photographs of an urban street scene. The same subject is presented in both photographs but one contains mostly architectural or built elements while the other shows a foreground of plants and turf. If you were selecting one of these photographs to be enlarged, framed and displayed in your home or office, which would you choose? If given a large choice of photographs, you probably wouldn't select either of these because the subject itself is not one of high preference. However, if the choice were limited to one of the two, most people would select the one with the natural elements.

It does not take many natural elements to increase the appeal of an urban scene. Imagine two views of an apartment complex. Both show the principal buildings in a landscape consisting of a paved plaza with sculptured features and structures for sitting. In one, there are no natural elements. In the other, a small row of trees have been added. Though the first scene is attractive, it would likely be less preferred than the other, whose natural features make it more inviting and thus increase its appeal.

Sociological Impacts of Nature

There are documented examples of urban communities that have been revitalized because of the introduction of nature into their neighbourhoods.

One researcher describes the sociological impacts of a tree planting program in Oakland Calif. The Oakland Tree Task Force, with aid from a citizens group, organized an eight-month tree planting project. Local residents were involved in the program and performed much of the physical work. Every effort was made to use the project as an opportunity to bring people together and establish a sense of shared ownership in and commitment to the neighbourhood.

Inner-city residents often have a poor image of, and sense of, not being connected with their neighbourhoods because of their environment of absentee landlords and general physical neglect. The tree planting program, by giving residents a feeling of involvement and a measure of control over their surroundings, spawned numerous paint-up, fix-up parties, neighbourhood watch associations and community garden projects. An atmosphere of community was frequently established that expressed itself in numerous ways long after the initial tree planting was completed.

This approach is not unique. Inner-city gardening projects have been enormously successful in most urban communities where they have been organized. The Philadelphia Green program sponsored by the Pennsylvania Horticultural Society has initiated more than 1,300 projects at a 1988 cost of more than $1.5 million. Featured on national television, this program has virtually transformed several depressed neighbourhoods of inner Philadelphia into vital communities displaying enthusiasm, pride and economic revival without displacing the original residents.

It is surprising, however, that such examples of urban rejuvenation go largely unnoticed and that programs that permit residents to introduce nature into inner-city neighbourhoods are rarely listed among priority approaches for addressing urban problems. ***It may be that the conventional wisdom that holds lawns, trees and flowers as purely decorative with little fundamental human value is so deeply ingrained in the minds of planners and city managers that they are blind to successful programs even in their own communities.***

It may seem ludicrous to propose that guns, drugs and violence can be effectively countered by the practice of urban horticulture. Although lawns and gardens cannot necessarily correct social ills, it is likely that the changes in the attitude and outlook of the residents could.

Physiological Impacts of Nature

Although the psychological value of nature in the human environment is supported by most pertinent research, there are a number of studies that show that nature can promote physiological benefits as well.

One study focused on the rate of recovery from stress using students at the University of Delaware. Volunteers (60 men and 60 women) were subjected to emotional stress by viewing a relatively graphic videotape of work-related accidents.

After a short rest, they looked at a tape of a natural setting or one of either vehicular or pedestrian traffic in an urban setting. Each tape was accompanied by an appropriate sound track set at a decibel level consistent with the scene being viewed. While watching the stressor and recovery tapes, subjects were monitored for the following physiological activities: muscle tension, skin conductance and pulse transit time (a non-invasive measurement that correlates well with blood pressure).

As expected, all subjects responded to the stressor tape with increased muscle tension, greater conductance and pulse transit time (elevated blood pressure). While watching the recovery tapes, all students exhibited a reversal of the stress measures, but those looking at the natural setting recovered more quickly and more completely. Viewing the street vehicular traffic or pedestrian traffic in a shopping mall caused a more prolonged duration of stress than did experiencing scenes and sounds of nature.

The authors concluded that everyday surroundings can significantly influence an individual's physiological state and rate of recovery from stress. Therefore, it appears that a preference for nature manifests itself at both psychological and physiological levels.

In a more 'classic' study, one researcher employed hospital records to assess the impact of a window view on the performance of patients recovering from gallbladder surgery.

Patients assigned to the surgical wing of a suburban Pennsylvania hospital between 1972 and 1981 were grouped into 23 similar pairs matched by sex, age, smoking habits, obesity, and previous hospitalization history. The rooms in the wing were identical except that half of them had a window that overlooked a park with trees, lawns and flower gardens, while the other rooms had a window view of the brick wall of an adjacent hospital wing. Data were collected only from patients who were admitted during the period from May 1 through October 20 when the trees were in foliage.

Highly significant differences in patient recovery performance were noticed between members of each pair. Those with a view of the park were discharged almost a full day earlier than patients with the view of the wall. The amount of pain medication required by the wall-view patients was about three times greater than for patients with the park view.

Apparently, the visual stimulus provided by a view of nature has beneficial physiological impacts that may very well derive from positive psychological responses. In any event, the experiences of nature positively influences both the mental and physical health of individuals.

Implications for Golf Courses

What does this have to do with golf courses and their management? It is clear that the natural environments that evoked the highest preference ratings and appeared to elicit the most positive physiological responses are just the sort of views common to a well-designed, mature golf course. The unobstructed views of trees, water bodies and other natural features with a smooth ground surface and a curved vanishing point that invites further exploration are all common to golf courses and are features that promote maximum preference. Thus, if you need to relax and seek relief from the stresses of life, you could find few places close to home better than a golf course. Perhaps this partly explains the enormous popularity of golf with people of all ages and socioeconomic statuses.

The presence of golf courses in urban or suburban settings should be considered community assets. Golf courses provide psychological and physiological benefits not only to those who utilize them directly, but also to passersby, nearby home owners and those who simply know they are close by.

Golf courses could be better integrated into the community fabric by incorporating hiking trails, picnic areas and benches for relaxation and observation of nature. This vision of golf facilities as positive contributors to the physical and mental health of the community and its residents could do much to dispel the image of elitism and frivolous extravagance in which they are sometimes viewed.

Evidence exists that strongly supports the value of open, park-like spaces to a community. It should take no leap of imagination to see golf courses in a similarly positive light.

[Reproduced with permission from Golf Course Management, Aug. 1994 and based on an address by Prof. Hull to the Turfgrass Section of the Crop Science Society of America Conference, San Antonio, TX., Oct. 1990]

The Role of Turfgrass in Environmental Protection

James B. Beard & Robert L. Green (Abstract of an Article in the J. Envir. Qual. 23: May-June, 1994)

Turfgrasses have been utilized by humans to enhance their environment for more than 10 centuries. The complexity and comprehensiveness of these environmental benefits that improve our quality-of-life are just being quantitatively documented through research. Turfgrass benefits may be divided into

- functional,
- recreational and,
- aesthetic components.

Specific functional benefits include

- excellent soil erosion control and dust stabilization thereby protecting a vital soil resource,
- improved recharge and quality protection of groundwater, plus flood control,
- enhanced entrapment and biodegradation of synthetic organic compounds,
- soil improvement that includes CO_2 conversion,
- accelerated restoration of disturbed soils,
- substantial urban heat dissipation-temperature moderation,
- reduced noise, glare and visual pollution problems,
- decreased noxious pests and allergy-related pollens,
- safety in vehicle operation on roadsides and engine longevity on airfields,
- lowered fire hazards via open, green, turfed firebreaks,
- and improved security of sensitive installations provided by high visibility zones.

The recreational benefits include

- low cost surface for outdoor sport and leisure activities,
- enhanced physical health of participants, and
- a unique low-cost cushion against personal impact injuries.

The aesthetic benefits include

- enhanced beauty and attractiveness of the landscape,
- a complimentary relationship to the total landscape ecosystem of flowers, shrubs and trees,
- improved mental health with a positive therapeutic impact,
- social harmony and stability,
- improved work productivity, and
- an overall better quality of life, especially in densely populated urban areas.

(*Ed. Note:* Copies of the entire article may be obtained by writing 'The Journal of Environmental Quality, 677 South Sogoe Road, Madison, Wisconsin 54711)

Renovating Turf by Sodding

Resodding old or damaged turf has important advantages over seeding, and intensive site preparation isn't always necessary.

Worn or damaged areas on sports fields can be repaired by several methods; working the site and seeding, overseeding and sodding. The latter system is often the most expensive, particularly where intensive working of the site is conducted prior to sodding.

The amount of tillage or site preparation prior to sodding is dictated by the need to reshape the surface and the time limitations on the use of the field. On many older fields the grade has already been satisfactorily established and only minor levelling, if any, is necessary.

Two factors need to be considered when assessing a turf renovation program by sodding. The first factor is the time of year. Weather conditions play an important role because sod laid in late spring or midsummer will be more subject to water stress, will require irrigation, and require more time to return to uniform growth and colour (up to two months) than sod laid in September, or even as late as November, after normal use of the field has stopped.

The second factor that needs to be considered is the amount of site preparation which is performed. Prof. Jack Eggens and Dr. Ken Carey conducted an interesting experiment to determine how much preparation was required prior to laying the sod. They began with a site where the old vegetation was killed ten to twenty days prior to sodding by the use of glyphosate. The old turf was scalped with a rotary mower and the debris removed. The treatments were applied in the spring, summer and fall to a mixed bluegrass/bentgrass/fescue sod on a high maintenance area with automatic irrigation.

Four different site preparation procedures were followed:

- sodding directly over the killed turf,
- addition of one inch of top soil, smoothing and sodding,
- vertical mowing to two inches, smoothing and sodding, and
- stripping the existing turf with a sod cutter and resodding on the bare surface.

The timing of the sodding operation had a significant effect on the appearance of the turf. Sod laid in either late spring or midsummer took up to two months to show no stress symptoms whereas sod laid in the late fall remained uniformly green and had fully recovered by the following spring (Table 1).

Removing the old sod with a sod cutter gave good soil-sod contact so that relatively rapid recovery occurred in 30 days, even when sodding occurred in mid August (Table 1). Although failure to remove the old sod had little effect on the rate of recovery when sodding was done in October, the August application of sod over the existing thatch, etc, in particular, resulted in a significant delay in the rate of turf return to full vigour. In fact, in the long term there were no differences observed between the different treat-

Table 1: The effect of site preparation and date of sodding on the rate of recovery of newly-laidKentucky bluegrass sod receiving high maintenance.

	Laid May 30			Laid Aug. 11			Laid Oct. 20		
	DAYS AFTER RESODDING								
Site Preparation	**10**	**30**	**60**	**10**	**30**	**60**	**10**	**30**	**60**
	(% recovery)								
No Preparation	20	65	100	5	60	100	100	100	100
Topsoil Added	40	75	100	50	95	100	100	100	100
Verticutting	35	75	100	60	95	100	100	100	100
Stripping Old Sod	85	90	100	95	100	100	100	100	100