

# CHAPTER 6. MAINTAINING TURF

## INTRODUCTION

This chapter describes sound practices for long-term maintenance of lawns in this region. How we take care of established lawns affects more than the immediate appearance of the turf—it also affects the long-term health of the turf and its resistance to pest attack. The sections in this chapter provide basic information on watering, mowing, grasscycling, managing thatch and aeration. These are practices that anyone can use to improve results, while conserving water and minimizing the use of fertilizer and pesticides.

## WATERING

The objective of watering practices should be to conserve water, while sustaining healthy turf. This section discusses the moisture needs of turf, irrigation practices to encourage deep rooting of the turf, and ways to conserve water.

Watering requirements for established turf differ from those for newly established lawn (which is discussed in Chapter 5, Establishing New Turf).

### Deciding Whether to Water

Whether or not to water depends on the soil foundation of the lawn, on the customer's preferences and on management practices. Natural rainfall is sufficient to meet turf needs throughout the early and late part of the growing season in our region. Prolonged mid-summer droughts are common, however, with up to 12 weeks with little or no rain. During this period, soil moisture levels drop as the water moves into the air by surface evaporation, and by evapo-transpiration from the leaves of plants.

Many lawns in our region stay green through our dry summers without irrigation, although growth rates slow as soil moisture reserves decline. This indicates that sufficient natural moisture is available in our region to maintain green turf, if the underlying soil foundation has the capacity to store the moisture (*see* Chapter 2 for information on the moisture capacity and capillary flow in soils). Healthy turf generally does not require irrigation in this region, unless it is subject to additional stress, such as occurs on playing fields.

If not irrigated, however, some turf will turn brown in midsummer. This does not harm turf. It is a sign that the turfgrass has become dormant, which is a natural response that enables grasses to cope with drought. The green colour returns rapidly after rainfall returns.

### Do Weeds Get Ahead in a Dormant Lawn?

Broadleaf plants (e.g., dandelions and clover) are more visible when turf is dormant because they remain green. They have deeper roots so can reach down to the scarce soil moisture. Although they stay greener longer than the turf, there has been little evidence that the populations increase as a result.

In some locations, the soil depth is not adequate to supply enough moisture. This can happen, for example, for lawns constructed on sites with solid rock a few centimetres below the surface. A homeowner or turf manager faced with a brown lawn in midsummer has a problem that cannot be corrected without a major rework of the site. They must choose between accepting the dormant appearance, and watering to compensate for the construction deficiency.

**Turf growth and colour normally returns after rainfall.**



Turf stressed from drought (left), recovered a week after rainfall returned (right). Note in the left photo that the area alongside the house remained green, because of the reduced moisture requirements in the shadow of the house. The area at the base of the hydro pole at the rear also remains green, possibly due to the mud in that area remaining from the hole dug for the pole, and the additional moisture storage reservoir it provides for the turf.

If the decision has been made to water through the dry period, then it should be done as efficiently as possible to conserve water and obtain the best results. The source of water should also be considered. For example, if water is drawn from wells, it is important to check that sufficient volume will be available from the pumping system and well, without disrupting the water quality or supply. Sustained high demands may drain a well, or cause murky water. Provincial regulations require a permit for well water usage above 50 cu m/day (about 8 gpm).<sup>1</sup> (Most home wells and pumps operate in the 5 to 10 gpm range.)

## **Turfgrass Moisture Requirements**

Water use varies greatly between species and cultivars, with fescue species requiring much less than Kentucky bluegrass turf.<sup>2</sup> It is generally accepted that healthy turf growth requires about 25 mm (1 in) of available moisture per week in the region.\*

Anecdotal reports suggest that about 13 mm ( $\frac{1}{2}$  in) of available moisture per week is enough to maintain the green colour in turf in our region.<sup>3</sup> With water conservation in mind, we suggest that

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\* Beard<sup>2</sup> cites a daily moisture requirement from 0.1 to 0.3 inches per day or 0.7 to 2.1 inches per week.

this figure be used as a target to be refined through observation and research in the upcoming seasons.

If the decision to water is made, there are two choices:

- apply enough water to keep the turf green, which requires about 15 mm ( $\frac{5}{8}$  in) per week, or
- irrigate enough to maintain vigorous growth, which requires about 30 mm (1.3 in) per week.

These application rates are somewhat higher than the targets cited above of 13 mm and 25 mm per week, to compensate for evaporation loss.

**Table 6-1. Water volumes required, by area, to provide 13 mm or 25 mm water, assuming an irrigation system operating at 75% efficiency.**

Watering once								
		1 sq yd	1000 sq ft	100 sq m	500 sq m lawn	1 acre	1 ha	100 homes @ 500 sq m
13 mm (1/2")	Imp gal	3	350	375	1,875	15,000	37,500	187,500
	Liters	14	1,600	1,700	8,500	69,000	170,400	850,000
25 mm (1")	Imp Gal	6	700	750	3,750	30,000	75,000	375,000
	Liters	28	3,200	3,400	17,000	138,000	341,000	1,700,000
Watering eight times through the summer								
		1 sq yd	1000 sq ft	100 sq m	500 sq m	1 acre	1 ha	100 homes
13 mm (1/2")	Imp gal	24	2,800	3,000	15,000	121,000	299,000	1,495,000
	Liters	114	12,800	13,600	68,000	552,000	1,360,000	6,800,000
25 mm (1")	Imp gal	48	5,550	6,000	2,900	242,000	598,000	2,990,000
	Liters	227	25,600	27,200	136,000	1,104,000	2,720,000	13,600,000

Cultural practices have a marked influence on water requirements for turf. Cutting with dull mower blades, using higher rates of nitrogen, and intense traffic all increase water demand.

On lawns affected by browning, some areas, such as on sunny slopes, will brown more quickly than others. Shady areas and the north sides of buildings will usually stay green longer. These areas can be irrigated less frequently, which saves water.

Water used by turf plants declines as soil moisture drops or as irrigation frequency decreases.<sup>2</sup> The deeper the roots, the better turf plants tolerate drought. Cultural practices that encourage deep rooting reduce irrigation requirements, as well as promote healthy turf. In contrast, frequent light sprinkling encourages the development of shallow roots, and should be avoided.

## The Need for Water Conservation

The amount of water used on the average lawn is surprisingly large. The decision to irrigate could consume 1,700 to 3,400 litres per week (*see* Table 6-1) assuming the irrigation system is operating at 75% efficiency. If irrigation is required for 8 weeks (supplemented with a normal number of rainfall events through the summer), this would require about 13,500 to 27,000 litres of water per

100 m<sup>2</sup> of turf area. This is 68,000 to 136,000 litres for a typical 500 m<sup>2</sup> home lawn. Evaporation losses from typical overhead irrigation systems can raise these figures significantly. The figures can be doubled by poor management of the irrigation system: for example, by leaving sprinklers running an extra hour or two, or allowing water to run down the curb or other hard surfaces.

At the municipal level, the numbers are more striking: irrigating 100 average sized lawns through an average season could consume 6,800 to 13,600 cubic metres of water (assuming no waste). Poor irrigation practices can easily double these figures. It is clear why this is a major concern for municipalities, especially since the water used on lawns is mainly of drinking water quality—our most valuable water.

There is a great deal of potential for reducing the amount of water used on lawns. This can be done right now through conservation measures. In the future, it can be done by introducing construction standards that require provision of a ‘sustainable’ soil base under lawns in new construction.

## **Sprinkler Design and Efficiency**

Every irrigation setup is different, with different equipment, delivery rates and soil conditions. Each setup should be carefully evaluated to maximize both irrigation efficiency and water conservation.

Irrigation delivery methods include overhead, surface and subsurface sprinkler systems. Micro- and drip irrigation and soaker hoses use water most efficiently. However, overhead delivery systems are the most practical for turf because they cover a larger area and less labour is required to move the units. Overhead units are available with:

- rotating nozzles covering full circles (some models can be set to cover part circles) with spike or flat plate bases, or
- oscillating bars on a plate or skid mount that delivers a rectangular pattern.

The units mounted on skid or plate bases are a bit easier to manage than the spike mounts. Also, units delivering a rectangular pattern are easier to control in confined areas and allow more uniform coverage with less over-spray onto sidewalks and driveways. They are also preferable during sod installation, because the more controllable pattern reduces interference with the laying crew.

Typical overhead lawn sprinklers deliver 8 to 20 litres (2 to 5 US gal) per minute, depending on nozzle hole size and water pressure. This is equivalent to rainfall of 3 to 25 mm (0.1-1 in) per hour.

For rotating sprinklers, the effective coverage area is about 65-70% of the total area wetted, in windless conditions. This is because the amount of water delivered to the surface tapers off toward the outer edges of the area covered. For such sprinklers, a 30-35% overlap of wetted areas is necessary to assure reasonably uniform application. The units with rectangular patterns seem to require less overlap to provide effective coverage.

Evaporation reduces sprinkler efficiency. As much as 50% of the water leaving the nozzle may be lost to evaporation in extremely hot, windy and low-humidity conditions.<sup>4</sup> For our conditions, a 75% efficiency (25% loss) figure is probably a fairer estimate. (Rain Bird and Nelson irrigation equipment catalogues provide good reference data on nozzle delivery rates and coverage areas.)

## How Often to Water

How often to water to apply the total amount required each week depends on the objectives of the watering program and the soil base under the lawn.

Most soils—even a 10 cm (4 in) layer of topsoil over gravel—can hold enough water from one weekly application to keep the turf green. That is, they can hold 13 mm (½ in) of available moisture, without becoming so saturated that water is wasted. If the decision is made to irrigate at this rate, a weekly watering (depending on rainfall) will suffice.

If the target is to water enough to maintain vigorous growth, it will require 25 mm (1 in) of water in a week. One weekly application of the full amount is usually more effective than applying half the amount twice a week, because it encourages plants to develop deeper roots. However, in sandy soils or shallow soils over gravel, this may result in a significant waste of water. If a lawn turns brown within three to four weeks after the last good rain, it may indicate that the soil is sandy, thin, or both.

In sandy soils, a single application of 25 mm of water will soak down as far as 45 cm (18 in), assuming no runoff.<sup>5</sup> If the topsoil is 15-20 cm (6-8 in) of sandy loam over gravel, or there are other disruptions to capillary movement (*see* Chapter 2) at least half of the water will move below the top layer of soil and be lost to the turf.\* Under these conditions, it would better to apply two, 13-mm applications per week (taking natural rainfall into account).

On heavy soils, 25 mm of water will soak in to a depth of 15-20 cm (6-8 in). If the soil is this deep, the full amount can be put on in one application. To check this, shortly after watering lift the sod in an out-of-the-way spot and dig down to the gravel layer. If the gravel is moist, it means that too much water has been applied. (The lifted sod won't be injured if it is replaced and kept moist for a few days). Cutting back on sprinkler time, and scheduling irrigation for every 5 or 6 days rather than weekly, can reduce this waste of water.

The soil infiltration rate is another variable that determines how much water can be applied at one time without waste. Light sandy soils on level ground can absorb 13-18 mm (0.5 to 0.75 in) of rainfall equivalent per hour, while heavy soils may accept only 2-6 mm (0.1-0.25 in) per hour. On slopes, infiltration rates may be 20% lower on 6-8% grades, and 40% lower on 9-12% slopes.

## How Long to Water

How long to operate the irrigation system depends on how long it takes that particular sprinkler and hose combination to deliver a given quantity of water. It all depends on the capacity of the soil to take up and hold that water. To determine this, the irrigation system must be calibrated.

Calibration is done in two stages:

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\* Loss of irrigation water may occur on thin soil over sand or gravel if the soil is watered beyond the saturation point, and surplus drains down through the gravel. (For a good visual description of this phenomenon, see Brady.<sup>6</sup>) The amount drained into the gravel cannot move back to the surface through capillary action and is lost to the plants

**The first stage:** Find how long it takes to apply 13 mm (½ in) of water to the surface:

1. Place 4 straight-sided cans of the same diameter about half way out in the sprinkler delivery pattern, then run the sprinkler for 15 minutes. (Using 4 cans improves the accuracy of the sample, and reduces the time required for the test).
2. Pour all of the captured water into one can and measure the accumulated depth of water. This will likely range from 6 to 18 mm (¼-¾ in). This total gives a reasonable estimate of rainfall equivalent per hour delivered by that sprinkler, compensating for evaporation loss on that particular day.
3. Use the following formula to calculate how long a particular sprinkler setup must run to deliver 13 mm (½ in) of water to the turf:

$$\text{Operating time in minutes} = \left[ \frac{\text{Target quantity (e.g., 13 mm)} \times 60}{\text{Accumulated depth of water}} \right]$$

Note that the delivery time established with this test will change significantly if a hose is added or removed from the setup. Because pressure drops due to friction loss in hoses, adding a second hose can cut sprinkler delivery volume in half, as well as reducing the area covered. If a second hose is required to reach some areas, the setup should be recalibrated.

**The second stage:** Find out how long the sprinkler can be left running in a particular spot before water runs off. Sprinkler operating times may vary for different locations within a particular site, because of different slopes, soil textures, traffic patterns and compaction. Some areas will require less water than others because they are less exposed to sun and wind. Reducing the sprinkler operating times in these areas conserves water.

On heavy soils or slopes, two or three applications separated by several hours, may be needed to deliver the target amount of water without causing runoff. Sprinklers with slower delivery rates are better in these situations (but are generally only available through irrigation supply outlets). Reducing delivery rates by adding a second hose is another option.

## When to Water

A great deal has been written about the proper time to water. It is logical to water when evaporation losses would be lowest and coverage patterns most uniform—meaning in cool, high humidity, windless conditions. These conditions are common in nighttime or early morning. Watering at these times, however, may mean less attention is paid to controlling the timing and efficiency of the application; this may result in a great deal of wasted water.

To put the potential for wasting water into perspective, consider that:

- watering to runoff can use two or three times more water than the lawn requires,
- leaving sprinklers running an hour longer than necessary can waste 50% of the water applied,
- allowing too much overlap on sprinkler patterns, or watering driveways and walks, can waste 30-50%, and
- loss to evaporation in hot, windy mid-day conditions may only be 10 to 20% higher than on cool, calm mornings.

In short, if the decision is made to irrigate, it is generally better to do it when work schedules permit. Applications should be postponed in extremely dry, hot, windy conditions. Monitor the areas closely to eliminate runoff, avoid applying excess water, and arrange delivery patterns to minimize over-spray onto non-turf areas. A sprinkler system with a timer (if it is managed correctly) is a wise, water conserving investment.

### **Water Conservation Tips**

Allow the turf to turn brown. This normally doesn't hurt the turf, and conserves water.

Rather than promote growth, consider watering just enough to keep the turf green; this takes about 15 mm ( $\frac{5}{8}$  in) per week (reduced by amounts of natural rainfall).

Water deeply, once or twice a week, to develop deep roots and stronger turfgrass plants. Avoid light sprinkling.

Use water efficiently: check delivery rates, apply just enough and stop watering before runoff occurs; water the turf, not the driveways and other hard surfaces.

## **MOWING**

Mowing is the most frequent maintenance operation carried out on turfgrass. It has both a functional and an aesthetic purpose, providing a neatly groomed, and sometimes patterned, appearance. It also provides an enjoyable surface for recreation, a safe, playable surface for various sports, and reduces fire hazards around buildings.

How you mow affects the health of the turfgrass. The following section covers mowing height and frequency and well as mower safety and maintenance tips.

### **Mowing Height**

The height of the mower setting largely controls the depth of roots. Using higher mower settings leads to a deeper, more extensive root system. This improves the ability of the plant to obtain moisture and nutrients from deep in the soil (*see* Figure 6-2). The result is a healthy turf, better able to compete with weeds, resist insect attack and withstand environmental stress, such as drought and

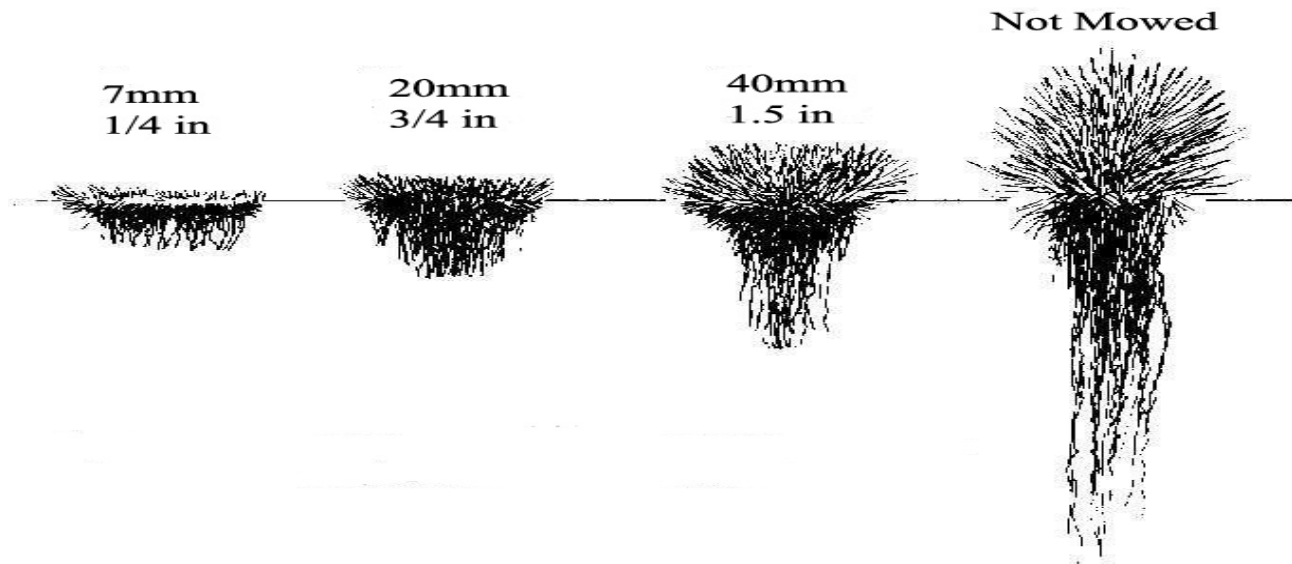


**Figure 6-1. Stressed turf caused by close mowing.**

temperature extremes. Recent research at the University of Guelph shows, even more strikingly, the effect of mowing on root depth in Kentucky bluegrass; it found roots were more than 2.5 times longer than mowing heights.<sup>7</sup> Generally, a mowed height of 6.5 to 7.5 cm (2½ to 3 in) is acceptable for lawns and amenity turf. As well as encouraging healthy plants, the increased height reduces the number of mowing operations needed for the season. Lower mowing heights create the illusion of a neater turf, but turf mowed at 7.5 cm (3 in) will look as neat as one mowed at 2.5 cm (1 in), provided the mower is sharp. A lawn with an uneven surface can even look better at the higher setting because there will be less scalping.

The photo above shows severe drought stress from close mowing. The stressed area is surrounded by green turf that was mowed at normal height.

Using sharp mower blades is very important. This ensures a clean cut, which improves the appearance and is better for the health of the grass plants. Using a dull blade tears the leaves, leaving a jagged or frayed wound that stresses the plant. This, in turn, increases moisture loss and gives the lawn a brownish cast for several days after mowing. Dull mower blades also require more power to drive them, increasing fuel consumption.



**Figure 6-2. Root depths of grasses at various mowing heights. Adapted from Emmons.<sup>8</sup>**

### **Does higher mowing cause later green-up in the spring?**

There have been reports of slow green-up in the spring on lawns cut at higher settings. This is particularly noticeable when the lawn is beside a closely mowed lawn.

Lawns turn green in the spring when the new growth appears above the layer of dead leaf blades left from the previous season. This means that the new grass blades will appear above a 7.5 cm (3 in) layer a few days later than above a 4 cm (1 ½ in) layer.

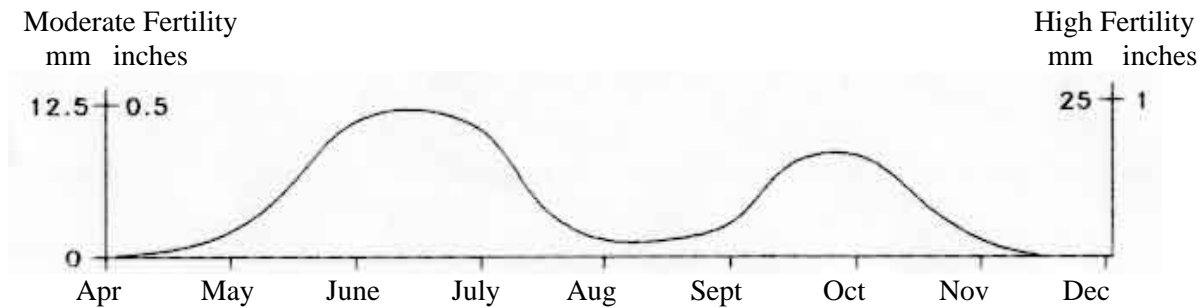
The problem is one of perception, since the turf is actually healthier at the higher mowing height. If the slightly slower green-up is an issue, the time can be shorted by lowering the mower cutting height setting for the last two or three cuts in the fall. As seen in Figure 6-3, growth processes are quite slow at that time of year so the lower height will have little impact on overall root growth.

### **Mowing Frequency**

To minimize the stress on turf plants, no more than one third of shoot growth (the portion of the grass blades above the surface) should be cut at any one mowing.<sup>9</sup> This is often referred to as the “1/3

rule” for mowing. Following this rule means that we should mow according to the rate of growth, rather than the calendar.

Growth rates differ widely throughout the season, depending on the temperature and availability of moisture. Figure 6-# illustrates a typical pattern of growth in non-irrigated turf. The daily growth rate peaks in June, and there is a second, lower peak in late September or early October. About two-thirds of the growth occurs during the spring, and the remainder through the summer and fall. The summer low is the result of the normal 8-12 week dry period that occurs in much of the Atlantic Region. While the seasonal pattern is the same for all non-irrigated lawns, the daily growth rate for a particular lawn depends on the underlying soil conditions and nutrients.



**Figure 6-3. Typical daily turf growth in New Brunswick without irrigation. (Adapted from Emmons<sup>10</sup> with growth data collected in NB research.<sup>21</sup>)**

The daily growth of shoots at the June peak can be 12.5 mm (0.5 in) or more. This applied to lawns on a good soil base with a moderate fertility program. Under a heavy fertilizer program, daily growth may approach 25 mm (1 in). Ryegrasses have a higher daily growth rate; as much as double that of bluegrass and fescues. Growth can be limited by lack of soil moisture and may actually stop when the turf becomes dormant during a dry, summer period. Under these conditions, water is the limiting factor and only the deep-rooted, non-turf species may show growth. The top growth of these plants will then dictate the timing of mowing. Each lawn will exhibit different growth characteristics for the summer, depending mainly on the moisture storage capacity of the underlying soil foundation.

**Table 6-2. Number of days to allow between each mowing to cut 1/3 of the leaf growth, at different growth rates.**

Daily Growth (mm)	Mower cutting height (mm)			
	40	50	62.5	75
	Mow when turf reaches (mm)			
	60	75	95	110
	Days between mowing			
3	7	8	11	12
6	3	4	5	6
10	2	3	3	4
15	2	2	2	3
20	1	1	2	2
25	1	1	1	2

Daily Growth (inches)	Mower Cutting Height (inches)			
	1½	2	2½	3
	Mow when turf reaches (inches)			
	2¼	3	3¾	4½
	Days between mowing			
1/8	6	8	10	12
1/4	3	4	5	6
3/8	3	3	3	4
1/2	2	2	2	3
3/4	1	2	2	2
1	1	1	1	1

Weekly mowing has been a normal practice throughout the region. However, during peak growth periods, this practice would remove more than a third of the shoot, particularly on heavily fertilized lawns. Not only does this stress the turf, but it also produces heavy clipping deposits that are too thick to leave on the lawn. The lawns loses the benefit of nutrients and organic matter from the recycled clippings, it takes more labour to transport and dispose of the clippings, and it places a strain on municipal landfills (*see* Grasscycling, below).

## Reducing Mowing Frequency

Mowing frequency can be reduced dramatically by:  
raising mowing heights, and  
reducing the growth rate.

Mowing frequency can be nearly cut in half by raising mowing height from 40 mm (1½ in) to 75 mm (3 in) – *see* Fig. 6-2, above.

Reducing the nitrogen rates will reduce daily growth significantly. Waiting to apply spring fertilizers until after the growth peak also reduces the rate of growth. This may also improve the health of the turf: some evidence suggests that spring nitrogen applications actually deplete nutrient reserves in the plants and weaken the turf.<sup>11</sup> (*See* Chapter 3, for more information on fertilization timing). Heavily fertilized lawns may require mowing almost daily at peak growth periods to follow the ⅓ rule.

### What if the lawn gets too tall?

Occasionally we get behind in our mowing schedule due to periods of wet weather, vacations, mower breakdowns, etc. Cutting at the regular height following these delays will remove considerably more than ⅓ of the plant and leave large volumes of clippings.

The preferred approach is to raise the mower cutting height, if possible, to remove only a third of the growth. Then repeat the cut within a few days, at successively lower heights until the normal mowing height is reached. This avoids excessive shock to the turf, and allows the clippings to be left on the lawn.

**Mowing Pattern:** Varying the direction of mowing in successive mowing operations promotes upright shoot growth. This reduces the formation of a horizontal growth orientation ('grain') and wheel tracks.

### Mulching Mowers?

Mulching mowers are becoming more popular. While they may improve the appearance of the lawn when mowing taller grass, there seems to be little advantage over a regular mower. They do not handle wet grass as well as a regular mower, which means a reduced mowing 'window'. They also generally have higher horsepower, with higher fuel consumption, than regular mowers.

## **Mower Safety**

Mowers can cause serious injury or property damage – either from direct contact with the blades, or from debris (rocks, sticks, cans) thrown by the blades. Operators should be aware of such hazards and protect themselves and others when mowing.

Important safety precautions:

- Keep hands and feet away from rotating mower blades.
- Keep bystanders – particularly children and pets - away from mowing equipment and operations.
- Always push a push mower. Never walk backward, pulling it with you – your feet can easily slide under the deck.
- Aim the mower discharge away from buildings, people and cars to reduce the risk of damage from thrown objects.
- Aim the clipping discharge onto lawn surfaces, not onto sidewalks or streets where they can wash into storm drains and river systems.
- Allow a gasoline mower unit to cool before refueling, to reduce the risk of fire.
- Avoid fuel spills. Partially filled fuel jugs are easier to control, reducing the chance of a spill.
- Wear safety glasses and footwear when using string line trimmers.
- Keep mowing equipment away from trees. Damage from mowers and string line trimmers causes serious injury to trees in landscape settings.

### **Mower Maintenance Tips**

- Maintain sharp blades to produce healthy, attractive turf and save energy. Rotary mower blades should be sharpened after 10-15 hours of operation in normal conditions. It is a good idea to keep a spare set of sharpened blades on hand.
- Balance the blades after sharpening to reduce vibration and prolong equipment life.
- To extend mower life, clean the grass off the underside of the mower deck after each mowing. A thorough cleaning and repainting at the end of the season also helps. Grass clippings are high in nitrogen; their corrosive action speeds up the rusting process.

## GRASSCYCLING

Grass clippings are a perfectly balanced, pollution-free lawn fertilizer.  
Leaving them on the lawn feeds the soil, not the landfill, and saves money in the process!

Lawns generate a lot of clippings. Although bagging and removing the clippings is a common practice, it adds time and costs to lawn care operations and contributes to the waste disposal problem for municipalities. In contrast, leaving the clippings on the lawn, ‘grasscycling’, has many advantages. It has been shown to:

- reduce fertilizer needs by 25 to 50%,<sup>12, 13</sup>
- cut labour for mowing and disposal of clipping in half,<sup>12</sup>
- substantially reduce demands on landfills,<sup>14</sup>
- improve overall colour of lawns,<sup>15</sup> and
- reduce weed populations.<sup>16</sup>

Studies show that the wet weight of lawn clippings ranges from 3.73 tonnes per ha annually (in a low fertility regime)<sup>15</sup> to 27.17 tonnes per ha annually.<sup>17</sup> This is equivalent to between 200 and 2700 garbage bags of clippings from one hectare of lawn (about 20 average sized home lawns). The burden this places on landfills is enormous—for example, before Michigan passed a law banning clippings in 1994, yard waste accounted for 20 - 25% of the trash disposed in landfills.<sup>18</sup> If clippings are removed from 10% of the turf area in our region, they represent a handling and disposal problem in excess of 100,000 tonnes annually.

A study<sup>18</sup> comparing plots with bagged clippings to grasscycled plots, reported:

- Grasscycled plots greened up earlier in the spring, grew faster, and stayed greener in the fall.
- Grasscycled plots had fewer broadleaf weeds than bagged plots.
- Bagging clippings nearly doubled the total mowing time compared to grasscycling.
- Bagging generated between 6 and 11 tons wet weight (1000 to 3800 cu ft) of clippings per acre per year.
- Neither the bagged nor grasscycled areas developed any thatch build-up.

### Nutrient Content of Clippings

The fertilizer value of clippings is an important reason for leaving them on the lawn.

- One report found that a year’s clippings contained 2.4 kg (5.3 lb.) of nitrogen, 0.8 kg (1.8 lb) of phosphorous, and 2.2 kg (4.8 lb) of potassium per 93 m<sup>2</sup> (1000 ft<sup>2</sup>) of lawn.<sup>19</sup>
- The nutrient ratio in clippings is about 5:1:3 (N:P:K), which is similar to that of high quality turf fertilizers. The nitrogen is in organic form, thus is released slowly with no potential to leach off site.
- Where clippings were removed, Beard found that the annual nitrogen fertilization rate had to be increased by about 1 kg per 100 m<sup>2</sup> (2 lb/1000 ft<sup>2</sup>) to maintain the desired colour and density of turf in Michigan.<sup>13</sup>

- A Guelph study reported that up to 40% of applied nitrogen is removed with clippings.<sup>15</sup> Based on this data, clippings removed from one hectare of lawn area may contain the equivalent of 17 to 56 bags of high quality turf fertilizer.

Clippings also add organic matter to the soil. This has been shown to improve the infiltration rate of water in comparison to sites where clippings were removed.<sup>20</sup>

## Grasscycling vs. Thatch

Research has shown that clippings do not contribute to thatch accumulation in a healthy lawn.<sup>21, 22</sup> With their high water content (87 to 88% in Fredericton tests<sup>21</sup>), they shrink rapidly and filter down through the turfgrass to the surface. Soil organisms (fungi and bacteria) decompose them quickly. Thatch can build up, however, in conditions where the activity of soil micro-organisms and earthworms has been suppressed. This can be caused by low soil pH, applications of fungicide, insecticides or excessive fertilizer, compaction or poor drainage.

### When is grasscycling not appropriate?

If more than 1/3 of the grass plant is removed in mowing, it takes longer for the heavier clippings, with their higher proportion of coarse stem material, to break down. In some cases, this can be overcome by running the mower over the area again to chop them more finely. In other cases, especially in wet weather, the excessive clippings may need to be removed.

## Recycling Tree Leaves

Leaves, too, can be recycled on to the lawn with the same benefits as grasscycling. Chop them up with the mower in the fall and allow them to compost into the root zone as an alternative to raking and bagging. A couple of passes with a mower will break down normal accumulation of leaves satisfactorily, and return valuable organic matter to the soil. Michigan studies reported that there were no adverse effects from mowing up to 15 cm (6 in) of different types of leaves into lawns.<sup>22</sup>

## MANAGING THATCH

Thatch is the dark brown mat of undecomposed plant tissue that lies above the soil. It is made up of stems, rhizomes, stolons, leaves, and roots. These products are high in lignin, which is tough for soil microorganisms to break down.

A moderate thickness of thatch (up to 2 cm or about 3/4 inch) is a necessary and beneficial part of a lawn. It:

- creates a cushion effect, binding individual grass plants together and helping to resist wear from foot traffic,
- mulches the soil, which reduces the potential for erosion and water evaporation,
- provides an important source of natural food for soil microorganisms.



**Figure 6-2. 25 mm Thatch Layer.**  
*Photo courtesy of Dan Dinelli.*

When the thatch layer is deeper than 2 cm (¾ in) it becomes a problem that can lead to declining turf health, shallow root systems, and reduced performance of pesticides.<sup>23</sup>

### **Thatch and Chinch Bugs: Is There a link?**

Excess thatch has been suggested as a contributor to chinch bug infestations. However, research at Laval University found no correlation between the thickness of thatch and chinch bug populations.<sup>24</sup> There was also no correlation found in New Brunswick studies in the summer of 2002.<sup>25</sup>

Potter<sup>26</sup> notes that excessively fertilizing turf results in higher than normal levels of nitrogen in plants. This makes them more attractive to insects because insects have a high need for nitrogen in their diet. Leaf-feeding insects grow faster, live longer and lay more eggs on heavily fertilized plants. Since excessive fertilization also favours thatch buildup, this may have led to the perceived connection between excess thatch and chinch bug infestations.

## **Causes of Excessive Thatch**

Excess thatch is a man-made problem. It develops when the dead organic matter from the actively growing turf accumulates faster than it decomposes. Any cultural or environmental factor that stimulates excessive shoot growth or impairs the decomposition process increases the rate that thatch accumulates.<sup>27</sup> Since earthworms and soil microbial activity decompose thatch, any practice that depresses this activity will result in thatch accumulation.

Thatch problems are not seen in turf where healthy earthworm and microbial populations exist in the soil. While we cannot see the soil micro-organisms, indicators that they are healthy would be:

- healthy turf growth,
- good levels of organic matter (2% or more) in the soil, and
- significant earthworm populations.

Factors that can suppress the earthworm and microbial activity needed to decompose thatch include:

- high fertilizer rates that stimulate rapid turf growth,
- low soil pH,
- applications of fungicides, some insecticides, and to a lesser extent, herbicides,
- compaction,
- poor drainage, and
- excessive irrigation.<sup>28</sup>

## **Preventing Thatch Problems**

Sound maintenance practices that encourage a healthy soil microbial population are the best approach to preventing thatch problems. These include:

- taking soil tests to determine pH, P and K levels and correcting any deficiencies,
- following moderate nitrogen application programs,
- using pesticides only when and where required, and
- correcting compaction or drainage problems if these are contributors.

Grass clippings are easily broken down and do not by themselves contribute to a thatch problem. If mowing schedules are adapted to the growth rate of the turf (and nitrogen fertilizer is used in moderation) there won't be an excessive quantity of clippings to overburden the decomposer microorganisms.

Little correlation has been observed in New Brunswick conditions between excess thatch accumulation and poor lawn construction (i.e., on shallow topsoil layers or poor soil). Thatch becomes a problem on these lawns when intensive management programs, using high fertilizer rates and regular pesticide sprays, are followed in an attempt to overcome deficiencies in the soil. Such intensive practices have been shown to suppress earthworm and microbial activity.<sup>29,30</sup>

Excess thatch accumulations have not been observed to date in New Brunswick in those lawns that stay green naturally through the summer drought, or in biodiverse lawns (e.g., lawns with significant clover populations).

## **Correcting Excess Thatch**

### ***“Compost eats thatch” – Don Legacy***

The key to correcting a thatch problem is to determine the source of the problem—then fix it. In most cases, excessive or overzealous fertilizer and chemical applications, combined with low soil pH, cause the problem. Moving to a sound maintenance program as described in the manual will stop further build-up of thatch. It is not clear, however, whether this measure alone will reduce an excessive thatch layer over time. If it works, this not only provides valuable organic matter to the soil, but it saves the cost and disposal problems associated with removing thatch mechanically.

Topdressing with properly matured compost has been shown to be an effective remedial measure.<sup>31</sup> Presumably, topdressing works by stimulating the soil microbial population, while also providing nutrients to the turf. Where thatch accumulations are very heavy, the process can be hastened by light aeration. This means just breaking the soil layer beneath the thatch to improve penetration of the compost into the thatch layer.

Avoiding insecticides that kill earthworms contributes to natural control of thatch. One study<sup>32</sup> reported that earthworm activity in moving soil into and above the thatch layer provided benefits comparable to topdressing with soil.

Mechanical practices, such as using a dethatcher or vertical mower to mechanically remove the bulk of the thatch, also correct a thatch problem. While it is economically attractive, mechanical dethatching removes a large amount of excellent, soil-building organic material from the turf. This also becomes a disposal problem and disturbs the seed bank in the soil, leaving sparse areas that are easily invaded by weeds.

Core aeration has also been used as a remedial practice. When done properly, so that tines penetrate fully, the thatch layer is somewhat broken up. Some of the soil is also moved to the top of the thatch

layer. If there is healthy microbial activity in the soil, the soil organisms help break down the thatch. As with dethatching, this approach also disturbs the seed bank and encourages weeds.

## AERATION

“Compaction is not a problem on home lawns, except maybe where the postman walks.” *Dr. Bob Sheard*

Aeration (or aerification) is a mechanical cultivation method that allows selective tilling of existing turf, without destroying the sod. This usually involves removing hollow cores or open spoons of soil from the lawn and placing them on the surface. The term may also refer to using equipment with solid spikes or blades to punch holes in the underlying soil.

Aeration is normally done to relieve soil compaction or to improve infiltration of air and moisture. It may also be used to help reduce the build-up of thatch. Using aeration after overseeding or topdressing can improve results by increasing the contact between the seed or topdressing and the underlying soil.

### “A Quality Aeration Job...”

Ken Pavely, currently the IPM program coordinator for Landscape Ontario after decades of field work, notes: “In my experience of thousands of lawns, a quality aeration job provides benefits by increasing soil oxygen, warming soils in the spring (which allows turf to thicken up), and, of course, bringing soil to the surface for thatch control.”

When aerating to reduce compaction, the soil must be moist enough to enable plugs to be completely removed. This usually requires soil moisture conditions close to field capacity. Most commercial equipment is designed to penetrate 75 to 100 mm (3-4 in). If the tines penetrate to the full depth, the operation will help alleviate compaction. It is difficult, however, to reach this depth in dry, compacted loam and silt loam soils. Under these conditions, even the heaviest equipment will penetrate only 25 to 50 mm (1-2 in). In effect, this is only about 1% of the soil volume in the 100 mm targeted depth, so results are likely to be disappointing.

To determine whether adequate moisture is present, check the length of the cores. If the cores are short, or tines are penetrating only part way, it would be better wait until the ground is softer after rainfall or irrigation.

Shallow penetration is acceptable when using an aerator after overseeding or topdressing operations. This is because the objective is only to push a portion of the applied seed or amendment material down into the soil.

The cores may be left on the surface to break down with normal traffic and mowing, or they may be broken up with a drag mat. After aeration operations, there is likely to be some weed invasion, caused by disturbing the seed bank that exists in topsoil. Weed invasion will be more pronounced in areas where turf is sparse or there are bare areas.

In this region, our winter freeze-thaw cycles do an excellent job of soil aeration. It is far more effective than all but the most exhaustive mechanical aeration efforts (e.g., triple or quadruple passes to full tine depth). To preserve the effect of natural aeration, restrict traffic on structurally weak soils (loam and heavier textures), for a week or two during spring thaw. In most home lawn and general turf, this – along with root growth activity - can largely eliminate compaction as a problem.

A healthy root system in turf alleviates compaction. If the plants are growing well, it indicates that the roots are doing their job and that there will be little benefit from mechanical aeration. This was clearly demonstrated in July 2003 at a topsoil recovery test site in Moncton. Tests with a soil compaction tester (*see* Chapter 2, page 8) in areas with bare spots showed root-restricting soil density or compaction at only 25 to 50 mm (1 to 2 in) deep. In contrast, probe tests in grassed areas, only 30 cm (1 ft) away, showed roots were not restricted by compaction even at 100-150 mm (4 to 6 in) in depth.

## **KEY POINTS**

### **Watering**

Use efficient irrigation practices:

- water deeply, once or twice a week,
- monitor applications to make sure all water soaks in, rather than runs off, and
- control the operating time for each sprinkler so that it delivers no more than the desired amount.

### **Mowing**

- Mow safely to protect yourself and others.
- Cut turf grass at a height between 6.5 and 7.5 cm (2½ -3 in).
- Remove no more than ⅓ of the leaf at any one mowing.
- Keep mower blades sharp for best results.
- Lower mower settings in the late fall to shorten spring green-up time.

### **Grasscycling**

- Leave the clippings on the lawn whenever possible; this reduces nitrogen fertilizer requirements by 25-50%.
- Cut no more than ⅓ of the total leaf height at one time.
- Recycle leaves as an additional source of organic matter for the soil.

### **Managing Thatch**

- Prevent thatch build-up with sound cultural practice.

- Check maintenance practices, and correct those that may impair the activity of earthworm and soil micro-organisms:
  - test and correct deficiencies in soil pH, P and K levels,
  - use moderate, properly timed applications of nitrogen, and
  - use spot treatments of pesticides, only where they are needed and at the right time to be effective.
- Correct compaction or drainage problems, if these are contributing to thatch build up.
- Correct excess thatch problems by natural rather than mechanical methods where possible.

## **Aeration**

- Protect natural aeration by restricting traffic during spring thaw.
- Ensure mechanical aeration operations are effective: carry out aeration operations for compaction relief when soil moisture conditions permit full tine depth penetration.

## **REFERENCES**

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<sup>2</sup> Beard, James B. *Turfgrass Science and Culture*. 1973. Prentice-Hall, Englewood Cliffs, NJ, pp. 276-277.

<sup>3</sup> Harvey, Karl. Personal communication. In his vegetable operation in Maugerville NB, he estimated that the silt loam soil on one farm provided about ½ inch of capillary moisture to his crops. Turf on an adjacent sod farm grown on the undisturbed soil profile remains green throughout the season. Some areas that were regraded without considering soil depth, compaction and capillary movement, routinely brown out.

<sup>4</sup> Emmons, R. D. *Turfgrass: Science and Management*. Third Edition, 2000. Delmar Publishers, Albany NY, p. 234.

<sup>5</sup> Emmons, op. cit., p. 212.

<sup>6</sup> Brady, N. C. *The Nature and Properties of Soils*. Ninth Edition. 1984. Macmillan Inc. New York NY, p. 95 (Figure 3.19).

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<sup>7</sup> Eggens, J. L. *Turf Management – Principles and Practices*. Study Guide. Eleventh Edition, 1998. Department of Horticulture, University of Guelph, Guelph ON. See Chapter 4, p.3 (Table 2).

<sup>8</sup> Emmons, R. *Turfgrass Science and Management*. Third Edition. 2000. Delmar Publishing, Albany NY. p. 200 (Fig 11-4).

<sup>9</sup> Eggens, op. cit., *See* Chapter 4, p. 6.

<sup>10</sup> Emmons, op. cit., p. 21 (Fig 2.8).

<sup>11</sup> Eggens, op. cit. *See* Chapter 4, p. 30.

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<sup>22</sup> Lyman, G. T. and P.E. Rieke. *Turf Tips: Mowing Lawn Turf*. 1998. Department of Crop and Soil Science, Michigan State University Extension. [www.turf.msu.edu](http://www.turf.msu.edu)

## **Managing Thatch**

<sup>23</sup> Emmons, Robert D. *Turfgrass Science and Management*. 2000. Delmar Publishers, Albany NY, p. 387.

<sup>24</sup> Emmons, op. cit, p. 386.

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