



BOWLS SOUTH AFRICA

**LEVEL 1
GREENKEEPING**

EDITION FOUR

- LEVEL ONE -

BASIC GREEN KEEPING

FOREWORD

In the major bowls playing countries bowls greenkeeping is a profession where the greens are managed by qualified professionals who will earn a reasonable living as full-time Green keepers. In Southern Africa the management of the greens is conducted on a two-tier system –

- The organisation being entrusted to a person called a Green Keeper (GKP).
- The physical work being carried out by Green keepers Assistants

The so-called GKP's are part-time volunteers who came into greenkeeping in the latter half of their lives and therefore would only have a limited period of usefulness to their club - and to greenkeeping in general. By the time they have gained sufficient experience they are usually also ready to retire.

The Green keepers Assistants are usually long-term employees who have not had any formal education but have learnt their trade from previous GKP's.

In any two-tier system it is essential that the participants should be able to communicate freely and to share their knowledge and experiences.

Unfortunately there will be a period, immediately after the new GKP has been appointed, when the GKP is heavily dependent on the advice he gets from his assistants and it is only during the latter half of his tenure of office that he is able to contribute with theoretical knowledge and practical hints which he has gleaned from other sources.

At the turn of the century, with many new inexperienced GKP's being appointed this hiatus in our system became more obvious.

Something had to be done to equip the newly appointed GKP with the knowledge it might have taken him a few years to acquire.

Bowls SA, being aware of the situation, initiated a Bowls Improvement programme which was aimed at making the basic tenets of good greens management available to both the GKP and his assistant. Initially Bowls SA made two books available to the GKP's -

! How to Assess and Grade a Bowling green

! Level One Book

The Level One Book concentrated on the basic theories of good greens management which could lead to the GKP qualifying for a Level One certificate.

It was, soon, obvious that the Level One book, on it's own did not address the practical aspects of good greens management without which the theoretical knowledge could not be applied successfully.

At the same time it was recognised that there was a need to standardise the procedures which are an integral part of the tasks carried out every day on the greens.

This book "LEVEL ONE GREENKEEPING" is an attempt to provide both the GKP and his assistants with the wherewithal to produce good bowling greens.

Dr CH Louw.

INDEX

PAGE	SUBJECT
2.	GREENKEEPERS
3.	SAFETY
4.	TAKING OVER A GREEN
5.	EQUIPMENT TO MAINTAIN A GREEN • Cutting Machines
6.	Mower
7	Settings • Setting depth of cut
10	Reversing the Cylinder
11.	Chains and Adjusters
12.	Clutch • Deflector Plates
13.	Teasing Equipment
14.	Rear Roller
15.	Verticutter & Groomer
16.	Bank Cutter • Knapsack
17.	Turf Doctor
18	MOWING
21	WATERING & DROUGHT MANAGEMENT
24	SPRING TREATMENT
26	THATCH • Removal • Macro Thatch
28.	GRASS • Growth
29.	PHOTOSYNTHESIS
30.	ROOTS
31.	SOIL & TEXTURE • Compaction • Sterilisation • Sampling
33.	GREEN SPEED
34.	FERTILISER • Nutrients required • Program
35.	pH IN SOIL • Managing soil pH
36.	TURFGRASS DISEASES & PESTS • Identification • Fungi • Fungicides
40.	ALGAE, DOLLAR SPOT, FAIRY RING, BROWN PATCH, RED THREAD, PYTHUIM BLIGHT.
45.	INSECTS • Effective Control • Pesticides Spray Rates
	NEMATODES, BLACK MAIZE BEETLE,
49	WEEDS
51	PESTICIDE SPRAYING RATES
52	EVALUATING A GREEN
60.	SURVEYING AND LEVELLING A GREEN

GREENKEEPERS

Greenkeepers must rely on the following points:

1. Scientific knowledge.

A lot of research is carried out on the development of greens and knowledge is exchanged continuously.

2. Experience.

During practice the greenkeeper will gain experience and records should be kept enable the next person to gain from his experience.

3. Observation.

Good green keeping is done by an alert greenkeeper observing everything possible on and around his green.

4. Liaison

Greenkeepers should continuously liaise with their district greens committee and attend refresher courses when available.

SAFETY

HANDLING EQUIPMENT

The correct handling of equipment is of the utmost importance to the greenkeeper and regulations laid down in the Occupational Safety Act must be adhered to.

1. Always ensure that you have an up to date FIRST- AID kit at your disposal, and that you are familiar with it's contents and the use thereof.
2. Ensure that you are familiar with the treatment of the following:
 - Electric shock.
 - Inhalation and misuse of chemicals
 - Heat fatigue and heat stroke
 - Burns (chemical & heat)
 - Bone fractures
 - Bleeding injuries
3. Ensure that you have access to emergency telephone numbers.
4. Always wear correct protective clothing.
5. **Do not** consume alcohol at least 12 hours prior to working with chemicals or machinery.
6. Ensure that there is no moisture or dampness in the vicinity whilst working with electrical components.
7. Store chemicals out of reach of persons not familiar with their use including children.
8. Store machinery correctly.
9. Never leave active machinery unattended.
10. All machinery must be inoperative whilst being worked on.
11. Always check that safety covers are correctly in place before.
12. When using electrical equipment, regular checks on earth leakage switches should be carried out and where not fitted, installation should be done immediately.
(Ensure the switch is accessible should the Club be locked).

TAKING OVER A GREEN THE FOLLOWING SHOULD BE OBSERVED:

SOIL.

It is important to know the soil on the green, as incorrect texture will always create a problem for the development of the green.

- Particle size.
- Clay content.
- Compaction.
- Soil sample report to check chemical balance.
- Macro thatch severity.

GRASS.

- Type of grass. (single variety).
- Adaptation to climatic conditions present.
- Degree of hardness.
- Recovery period.
- Watering requirements.
- Mowing requirements.
- Resistance to fungi and disease.
- Frost tolerance.
- Run rate.
- Potential to develop nap.
- Shade resistance (especially in winter)

LEVELS.

It is important to know the levels as a long repair period may have to take place.
(Important to know Silverton blue cannot take more than 5mm of top dressing.)

WATER.

Is there an adequate supply? Borehole must be checked.

TREES & SHRUBS.

These may have to be removed.

DIMENSIONS

Ensure they conform as alterations may have to be carried out.

INVENTORY.

Compile an inventory and ensure it is signed by the committee.

MACHINES.

Check all machinery is in good working order as it could become a costly exercise to restore them.

Check there is sufficient equipment.

EQUIPMENT TO MAINTAIN A GREEN.

- Cutting Machines.
- Verti -cutters.
- Bank Cutters
- Rollers (medium, dew, drying and roller polisher.)
- Knapsack.
- Watering Equipment.
- Turf Doctor
- Soil Sampler.
- Drag Net.
- Sieving Equipment.
- Toolbox.
- Levelling Equipment.
- Scale & Measuring Jug
- 200lt Mixing Drum or Fertiliser Spreader

CUTTING MACHINES.

Rotary Mower.

These mowers are used for maintaining the surrounds and on top of the banks; it is not advisable to use a Flymo type on top of banks as incorrectly used tends to round the top edge.



ROTARY MOWER

Cylinder Mower



CYLINDER MOWER

It is important to carry out regular checks before the cutting program begins.

If the mower is moved over rough terrain without the proper cradle the settings must again be checked as follows:

- Check and adjust the cylinder blades to approximate with the bottom blade.
- Check height of cut.

- Check height of teaser comb.
- Check lubrication points are not dry.
- Check chain tensions.
- Check rear roller alignment.
- Check electrical connections.

MOWER

The mower is designed to produce a perfectly flat cut on the surface of the green. Incorrect settings will cause the cut to be shallow or deeper on one side causing ridging or stripes.

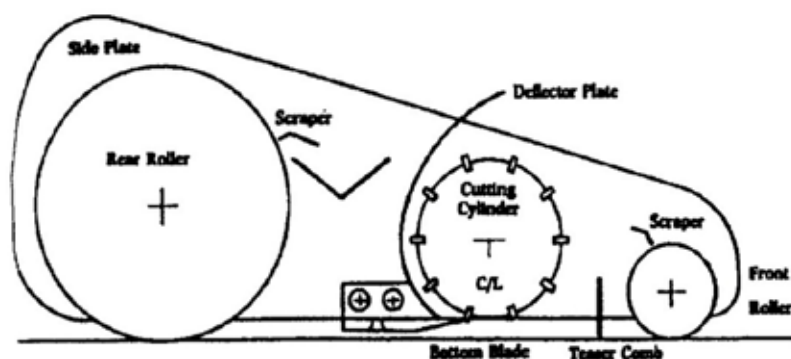
When moving the mower from the shed to the green or from one green to the next the settings must always be checked before cutting.

Incorrect settings will cause the cut to be shallow or deeper on one side causing ridging or stripes.

Ridging or Stripes

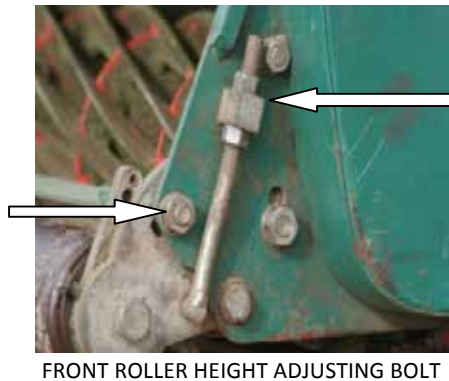


Side View



MAINTENANCE AND ADJUSTMENT OF PROTEA MOWER

Fig 1



Mower Adjustments

Before setting the mower one must ensure that it is disconnected from the main supply.

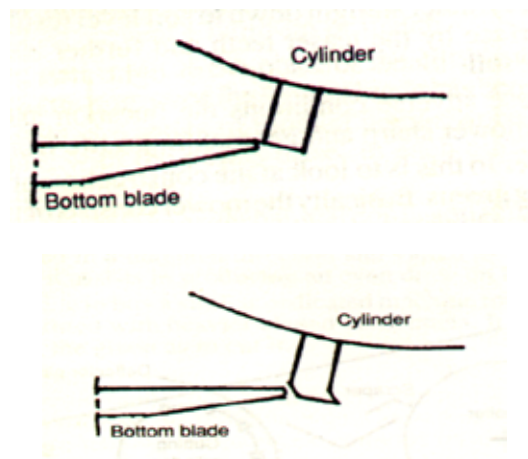
Setting the mower.

This should where possible be carried out before each use. The spiral blades of the rotating cylinder sweep over the front top of the bottom blade acting like a guillotine.

The leading edge of the cylinder and top edge of the bottom blade must be kept sharp at all times. Any burred edges must be dressed with a file, or back lapping should be carried out to ensure sharp cutting.

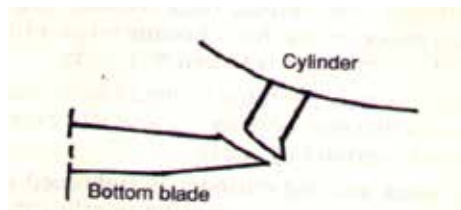
From the diagram it will be noticed that the bottom blade is set behind the centre line of the cutting cylinder. This fact coupled with the fan action of the cylinder produces a brushing effect to lift the grass up against the bottom blade as it moves over the green. The blades of the rotating cylinder sweep over the top edge of the bottom blade acting like sharp scissors.

The cylinder blades wear as in the diagram below.



When the blades are blunt it is natural to screw the cylinder down harder onto the bottom blade.

This causes a rubbing effect and wears the blades more quickly as shown below.



Blunt Mower -- Grass Shredded



When the blades become blunt on the cylinder it is possible on most machines to reverse the cylinder. As a rule one should always fit a bottom blade when worn or when reversing a cylinder.

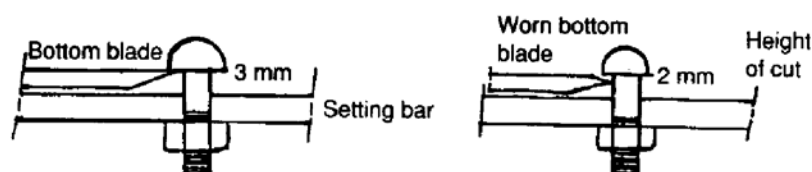
After installing the blades check across the full width of the blade for cut and if necessary shim the bottom blade with paper.

The mower should now be back lapped by inserting a fine A – grade water based carborandum powder and turning the cylinder in the opposite direction to cut. When back lapping is complete, wash off powder. The mower must now be reset.

Setting the depth of cut.

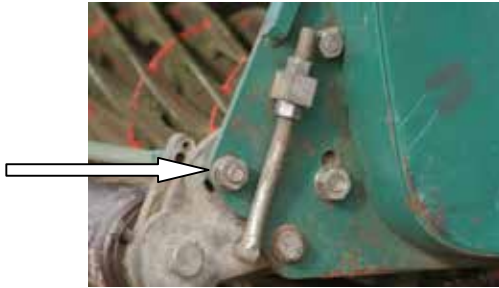
The depth of cut is set according to the type of grass on the green. After the setting bar is set to the required depth and the screw has been locked, the bar is then inserted with the screw on top of the cutting edge of the bottom blade and the rear rests on the bottom of the rear roller, as in the diagram.

If the bottom blade is badly worn a false setting will be achieved as shown below.

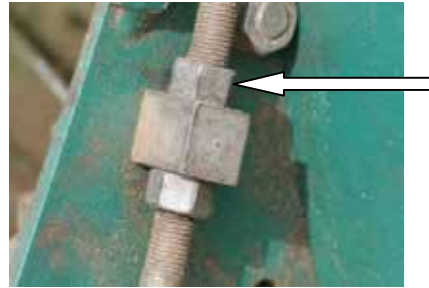


Cutting height adjustment is carried out by means of adjusting the front roller up or down. Lay the mower back on the handle. Fig 1 shows the front roller locking nuts on both sides of the mower. These nuts are loosened before the height adjustment is carried out.

Fig 1



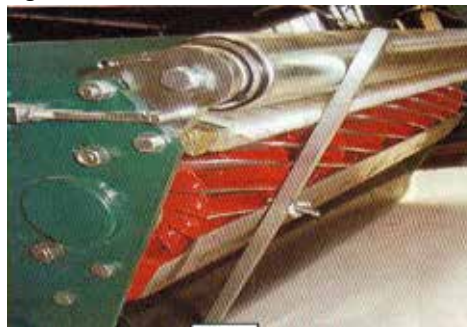
Front Roller Locknut



Front Roller Adjustment Bolt

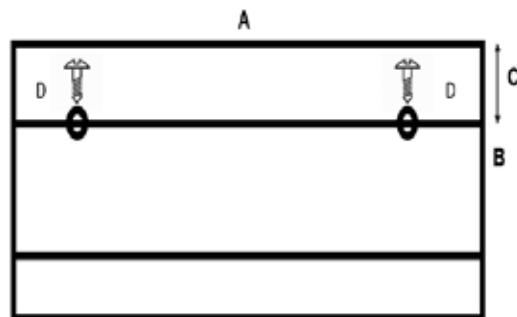
Ensure that the correct cut height is set on the adjusting bar screws prior to inserting between rollers. Now place the height adjustment bar as per fig 2. Adjustment is carried out by turning the locknuts up or down as per fig 1 on left and right side of machine.

Fig 2



Height Adjustment Frame

Fig 3



An adjusting frame as per Fig 3 can be made up as follows and will ensure a more accurate setting preventing "out of square" alignment.

Frame is made from 25mm x 5 mm angle iron and must be perfectly level when constructed.

A = Width of mower minus approx. 50mm from edge on both sides of mower.

B = Distance from center of front roller to rear drum roller. (Same as bar issued)

C = Distance from center of front roller to edge of bottom blade

D = 6mm Threaded screw hole positioned approx. 120mm from edge of cross beam.

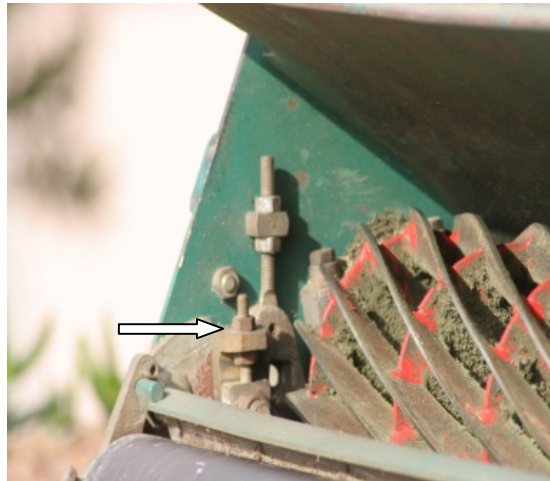
Screws and distance from top of bar are same as on adjustment bar. Lock nuts are fitted to adjusting screws. Prior to placing bracket in place the front roller is loosened.

When the frame is positioned on mower with the adjusting screws set correctly for the cutting height, the front roller is positioned on to the angle iron frame cross beam. The locking nuts for front roller are tightened.

This will ensure no striping or ridging when cutting.

After the cut height has been set the cylinder contact with the bottom blade must be checked. Adjustment is carried out by slacking the locknut on the cylinder hanger clamp as in Fig 4.

Fig 4

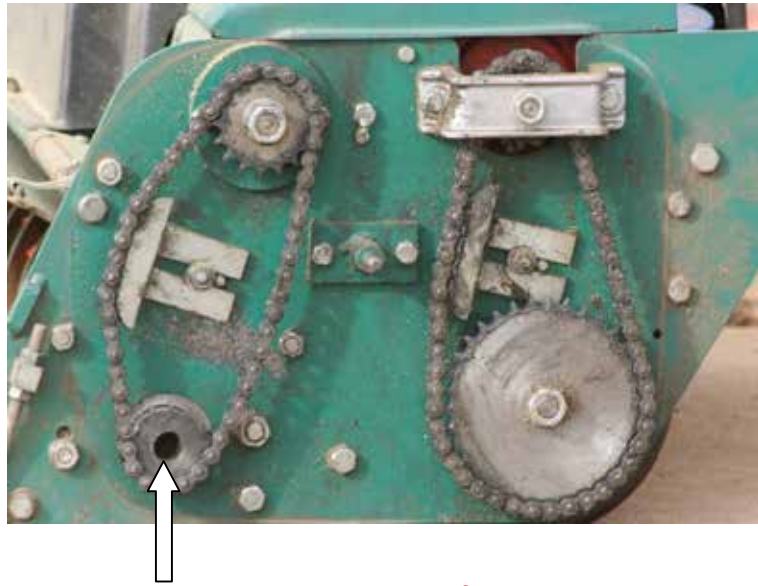


CYLINDER ADJUSTMENT BOLT

Always adjust cylinder to bear lightly on bottom blade or excessive wear on cylinder and bottom blade will take place also causing unnecessarily heavy load on the motor. Once adjustments have been carried out ensure that all bolts and nuts are locked.

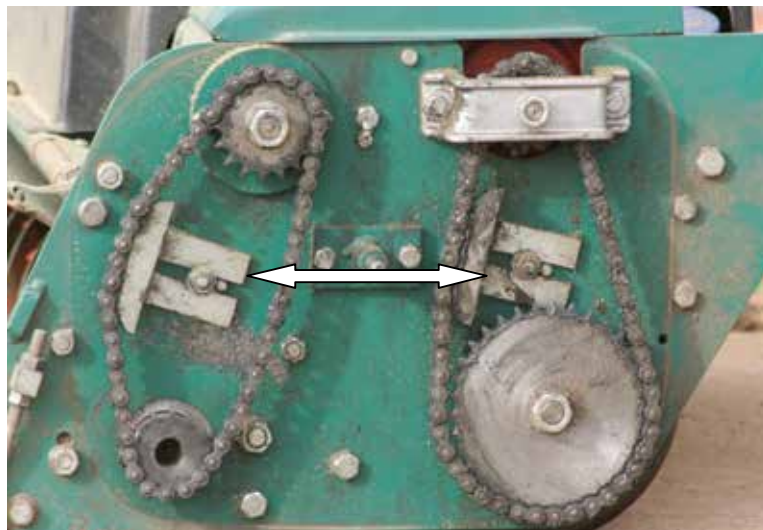
Reversing the Cylinder

When reversing the cylinder never remove the cylinder bearing hangers. Remove the bearing caps only. The caps must not be changed over and must be replaced in its original position. (**Mark them prior to removing**).



The sprocket to loosen on the cylinder is a left hand thread.

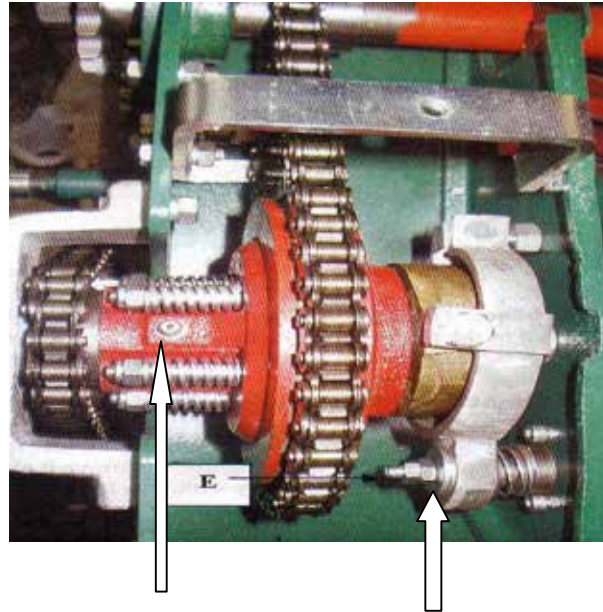
Chains and Drive Chain Tension Adjusters



Adjustment is carried out by means of loosening tensioners as indicated above and sliding the tensioner in the desired direction. Chains must never be adjusted tightly. It is advisable to leave the cylinder chain with a little slackness so that a slight adjustment of the cylinder can be carried out without having to re-adjust the chain each time.

Clutch

Fig 5



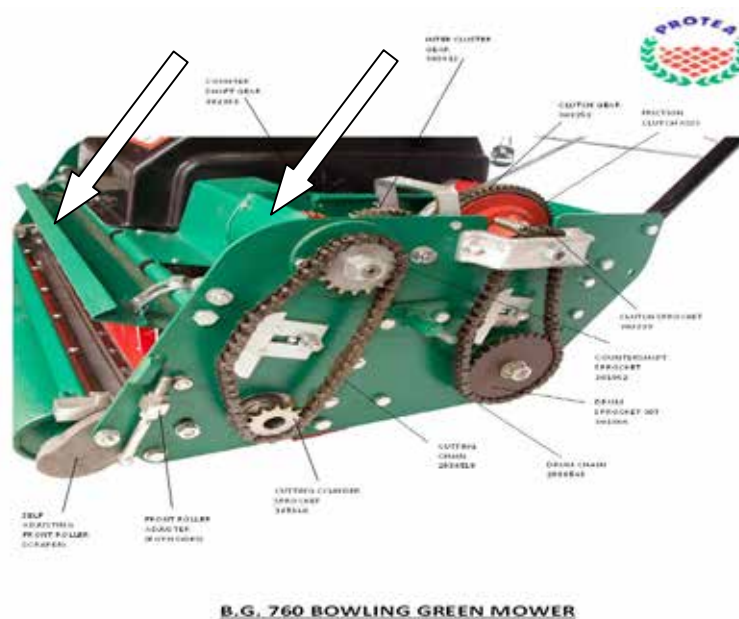
Lubrication Point

Clutch Adjustment

Clutch assembly as above must also be checked on a regular basis.

To be certain that the clutch is fully engaged without possibility of slip, there should be approximately 35mm free movement at the operating lever knob. This adjustment is carried out by adjusting the self-locking nut as per Fig 5. Use medium grade oil to lubricate clutch at lubrication point as seen in Fig 5.

Deflector Plates.



Deflector plates are set to ensure that the grass cut is thrown into the bin and must always be checked before mowing to prevent cuttings being left on the surface of the green. Grass trough on side of mower must always be in place when mowing as this will prevent dirt build up on the rear roller also collecting finer cuttings.

Setting the grass deflector plate is provided for and should be adjusted to obtain a good throw of grass into the bin.

Scrapers

The roller scrapers must also be set in order to remove grass or soil.

Teasing rake or Brush

Teaser Brush



The teasing rake or brush lifts out dry thatch and runners.

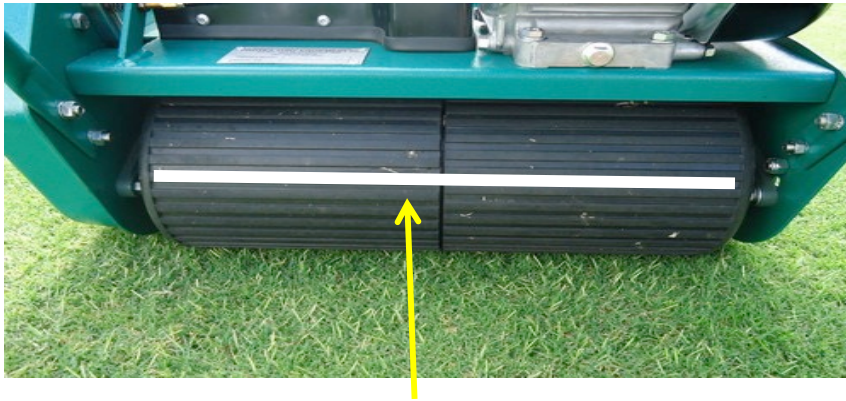
BEWARE OF THE FOLLOWING:

- Setting the cylinder too tight against the bottom blade, causing strain on the motor.
- Chains too tight, bring rapid wear of chains, sprockets and overload to the motor.
- Excessive lubrication to clutch housing causes slip, slow speed and overheating.
- Teaser too low tears the turf and overloads the motor.
- Electric cable too light causes low voltage and can damage the motor.
- Electric cable wrapped around handle of machine or extension drum acts as a transformer and can result in damage.
- Deflector plate incorrectly set.
- Faulty bearings on rear roller will cause mower to pull to one side.
- Blunt blades will cause bruising of the grass or shredding as shown below.

REAR ROLLER

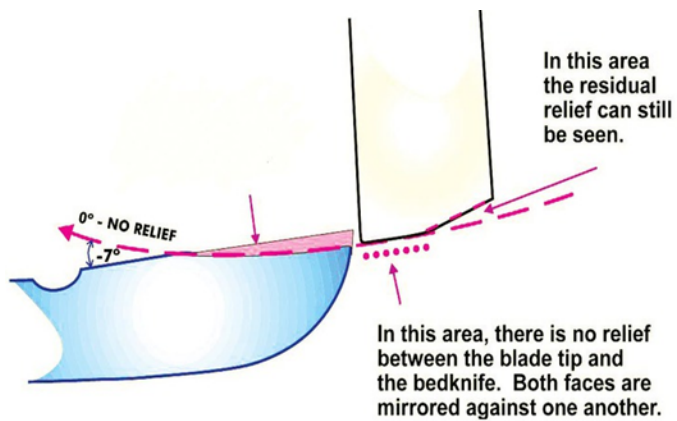
To check wear on roller bushes, after placing chalk line on roller, the person checking must now align his eye with the frame at top. Roller is now pulled back slowly and chalk line should be aligned with metal frame. Should the line not align with frame the bushes are worn, this will also when the mower is in operation tend to pull to one side.

CHECKING WORN REAR CYLINDER



CHALK LINE ACROSS ROLLERS

Cylinder contact to bottom blade



Approximation of Cylinder Blades and Bottom Blade.



Bottom Blade

BOTTOM BLADES

When reversing a cylinder always change the bottom blade.

Do not try to sharpen a bottom blade.

VERTICUTTERS.

These are cutters used to cut the grass in a vertical position, and assist with the removal of thatch build-up which ensures deeper penetration of water, air, sunlight and nutrients to the root system.

There are different types in use as listed

- Offset reel type is used for total removal of all turf on sandy or softer conditions.
- Pin type is used for removal on hard surfaces.
- Grooming reel type is used for removal of thatch and to achieve faster green speed without reducing the height of cut.
- Verti-cut reel not only removes thatch, but by means of its deep slicing penetration relieves compaction and improves surface drainage.
- A brush fitted to a mower or groomer acts as a teaser to the turf and removes thatch.

GROOMER



VERTI CUTTER



One of the most important things you can do to improve your fine turf is to add turf grooming to your regime. Unfortunately, turf grooming is not well understood and it is often confused with verticutting.

Grooming and verticutting serve different needs for the professional turf manager - both are necessary and important.

Grooming is carried out during growing season. One should inspect the bin to ensure 70% Thatch – 30% Green. When growing season slows 60% - 40% will be noticed.

Start of Winter – 50% – 50% will be noticed. Stop Grooming.

What happens if I don't groom?

An organic layer of thatch will tend to form. Grass growth will occur at the top of the canopy rather than at the true plant crown. As a result, the following conditions will compromise the health and growth of the plant:

- Root growth will diminish due to poor soil and gas exchange.
- Organic material will not properly decompose because of reduced microbial activity
- The thatch layer will trap moisture, fertilisers, pesticides, and herbicides, preventing them from reaching the soil and roots.
- Verticutting will be required more frequently to reduce and remove excessive plant materials if grooming practices are not in place.

BANK CUTTERS

This is the ideal machine to give your banks the professional look. Adjustable to most bank angles. When using this machine one must ensure that the ditch boards are in a straight line or damage may result in certain areas where the boards are closer to the bank.

Bank cutter for Grass Banks



KNAPSACK

This tool is used for spraying Herbicides, Pesticides and Insecticides on the bowling green and has different nozzles for these purposes as listed below:

HOLLOW CONE = FUNGICIDES + HERBICIDES

Low volume to high pressure 40 lts per green.

FLAT FAN = INSECTICIDES.

High volume to low pressure 80 lts per green.

A powder can be added to the knapsack which indicates a blue colour for the area sprayed. Spraying must be done at walking speed approximately 1m per second. This should give 4 fillings per green.

KNAPSACK



TURF DOCTOR

This tool is used when replacing sods in bare areas.

It is important to know that when a sod is removed from the green it is important to replace the new sod from the edge of the green and the edge must be replaced from the nursery.

When replacing a sod it must be replaced in the same direction as the one removed from the edge of the green.

TURF DOCTOR



MOWING

“Mowing” is the term we use to describe the various cultivation practices the greenkeeper employs to control the growth of the turf grass and to maintain it at the desired level for a bowling green surface.

- Mowing should take place every day when possible during the growing season and tapering off to-wards the autumn.
- Mowing should not take place if the grass is wet or damp as this can cause the following problems:
 - Slipping of the rear roller.
 - Incorrect height with soft surface.
 - Grass to slip between cylinder and bottom blade causing bruising and uneven cutting.
 - Electrical shorts.
 - Teaser comb to clog causing surface damage.
- Turning the mower correctly is of great importance as damage to the surface can result if carried out incorrectly. Operators have the tendency to stop after each turn, raise the front roller and release the clutch. This nets instant clutch engagement and the front roller crashes down on the green, causing the bottom blade to bury deeper into the grass causing the teaser to rip the surface resulting in damage to the cylinder and bottom blade. Too much clutch engagement also results in quicker worn parts.

BAD TURNING



- Always ensure the filing tray is in place as this helps to scrap the rear roller of large pieces of earth which causes incorrect height cutting. It also assists in collecting the fine grass which accumulates on the surface encouraging thatch build-up resulting in fungi and insects on the green.

The greenkeeper should keep a watchful eye for any irregularities which show up after mowing. Irregularities are symptomatic of faults in the mowing itself. E.g. in the adjustments, worn bearings or alignment.

The most important features that can affect the mowing quality are:

- Single and not double cutting (Always double cut).
- Speed of the mower.

Normal Speed: 5,1 k.p.h – (127 cuts per meter)

Low Speed: 3,3 k.p.h – (183 cuts per meter)

While the faster cut will produce an acceptable cut the slower speed will always have the smoother cut.

Direction changing.

It is important that a greenkeeper understands the meaning of the words “THE NAP” of the grass.

The Nap of the grass is when the leaves of the grass tend to grow towards the morning sun. (A good example is we have all seen sunflowers turn with the direction of the sun to assist with better growth.

Depending on the texture of the grass the bowl will always be pushed against the grain of the grass.

To check the NAP of the grass hold a pole on the bank of the green at the east side at 8h30 so that its shadow falls across the green, to indicate the start of the Nap cut. This should be carried out at least once a week.

The first cut must start at the western side of the green and proceed towards the east and return on the same line as this will give a smoother cut appearance.

Never mow in the same direction on successive mowings, always change direction.

The Perimeter

The perimeter of the green (Outer 3.0 m) is exposed to more wear than any other part of the green mainly player traffic and machinery turning in that area.

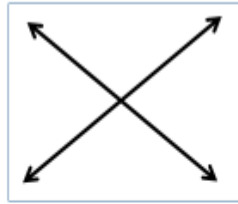
Because of the increase in damage to the grass plant the defence mechanism is under stress and there is a greater need for Carbo-hydrate reserves to be built up in this area than anywhere else on the green.

The greenkeeper must ensure that the grass plants in this area are capable of producing more CHO and he should create a picture-frame effect by:

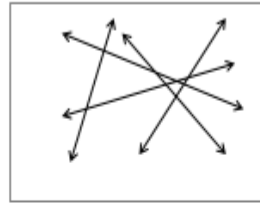
- Raising the mowing height over the perimeter.
- Mowing the perimeter only once a week
- Retaining the same mowing height all round but only doing a single cut on the perimeter.
- Leaving a thicker mat on the perimeter by not thinning out too vigorously.

MOWING PATTERN

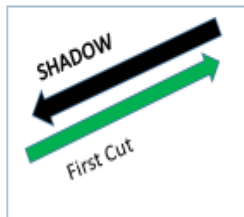
Corner to Corner



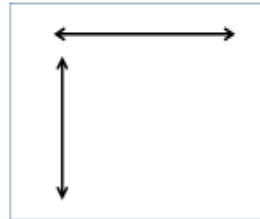
All Directions



NAP Cut



Straight



Picture Frame around Edges



Single cut once a week



WATERING AND DROUGHT MANAGEMENT

Water is involved with all phases of care and management of turf grass, i.e: germination, cellular development, tissue growth, photosynthesis, temperature control and as a carrier of nutrients in the soil.

Turf grass actively growing is generally 75 – 85 % water.

Transpiration

As turf grasses transpire, water moves up through the plant via the roots. As transpiration increases there is a greater suction imposed on the soil solution drawing water towards the plant. Water is continually lost through the plant by means of transpiration. Transpiration is influenced by temperature, wind and humidity. As the temperature increases there is a tendency for the plant to lose water for cooling the leaf surface under windy conditions. Evaporation from the leaf is high and transpiration is high. Under conditions of high humidity transpiration decreases.

Deciding when to water.

The main methods are usually as follows:

- Hit or miss
- Careful observation
- Using instruments
- Using evaporation figures



Bad practice

Method of applying water

When watering it is preferable to have infrequent, deep watering instead of frequent light irrigations. Irrigation should attempt to water to the depth of the root zone. This method encourages good root development. The irrigation system should have the following characteristics:

- A. Apply the required volume of water to root level.
- B. The irrigation rate should not exceed the infiltration rate of the soil.
- C. Even application of water as poor water distribution especially on uneven surfaces leads to over watering of lower areas.
- D. The distribution pattern should not be significantly affected by wind.

Time of watering

The best time to water is early in the day. This allows the grass to dry off quickly and reduce the likelihood of fungal attack. This is particularly important in the hotter months when dollar spot and brown patch are prevalent. Watering in the evening or late afternoon means the grass is moist for 12 – 14 hours creating good conditions for fungal attack. Watering in the heat of the day is undesirable because the turf is likely to be damaged.

Drought management

Drought management does not start when water restrictions are imposed. Although the greenkeeper normally knows well ahead that limited water restrictions followed by complete prohibition may be imposed within a certain space of time, he should at all times be aware of the possibility that a drought situation could be in the offing.

Where a Club relies on underground water for its needs the possibility that the supply might suddenly dry up must always be borne in mind.

During the months of November to March most of our grasses are in their prime growth. It is at this time where the use of our irrigation should yield the best results.

In RSA we are continually confronted with potential water shortages, therefore it is important to look at which role water plays in producing good greens.

Planning drought management

Mowing

Proper mowing techniques can make a big difference in whether your green is healthy and able to survive the stress of infrequent rains and water restrictions the objective would be to reduce those operations which increase stress in the grass plant while exposed to drought conditions.

With the onset of watering restrictions the greenkeeper should immediately warn members that he will be obliged to increase the mowing height by, at least, one millimeter. The increased leaf area would produce more CHO and at the same time reduce the stress on the grass plant and the defense mechanism.

Irrigation.

Having sufficient moisture in the root zone is the cornerstone to the health, growth and survival of the grass plant.

With a deep, strong and healthy root system the plant will be healthy, vigorous and more resilient.

Having sufficient water in the root zone is essential, one must not over irrigate as this will disrupt the balance of air and water in the soil. If the solid soil particles in the root zone constitute 50% then the remaining volume must be made up of 25% water and 25% air. When this balance is disrupted that the plant goes into stress mode.

To encourage a deep root system, one must irrigate depending on soil texture once or twice deeply. Loam soils once weekly and sandy soils twice weekly.

Use a rain gauge to measure how much water you are putting down and then determine how long you want your system to run.

Soil dries from the surface downwards, and under these conditions the roots will grow downwards into the soil towards the moisture. One must not encourage shallow root zone by under irrigating.

Tips when to irrigate.

The first signs of heat stress are wilted leaves, purple /grey or blue leaf colour and loss of resiliency. (Your foot print remain on the green when walking on the grass).

Dry spots may need more watering.

Nutrition

Avoid fertilisers high in nitrogen (N) and Phosphates (P).

Fertilise with Potassium (K) as this will make the plant more resilient.

Use Kelp P Max to promote root development and so to optimise water uptake.

SPRING TREATMENT

It is important for greenkeepers to carry out an annual spring treatment at the correct time of the year, normally this being Aug – Dec. It is important to study the rainfall pattern, as when levelling has been carried out a sudden heavy downpour could wash away the loose sand on the surface, causing indentations.

Banks and ditches may have to be corrected before spring treatment is carried out. Bare and weak areas must be rectified in advance to enable the rectified areas to bind into the soil to prevent the level rails from removing the turf.

The following steps are a guideline as to how spring treatment should be carried out.

Assess what is to be done on greens and surrounds by completing Evaluation sheet.

June: 1st Week.

- Stop fertilizing.
- Record levels. (Every Two Meters)
- Compile Estimated Season Costs form.

Discuss with Committee:

- Costs
- Closing and Opening times.

Order:

- Sand (greens + banks)
Sieve and sterilise if necessary

TOPDRESSING

Compatibility is a critical factor when selecting a topdressing, the topdressing must be compatible with the rootzone it is being applied to, and therefore any decision regarding the selection of a topdressing must first consider the rootzone.

- Machinery (Hollow tine or Verti-drain).
- Grass if necessary.

July: 2nd week.

- Soil sample. (At least six samples per green)
- Kill all foreign grass.
- Replant areas where necessary

August:

- Check results of Soil sample.
- LIME if necessary.

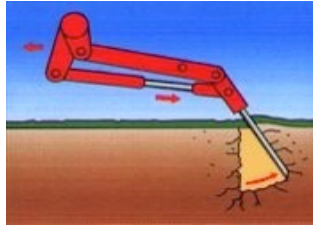
Sept/ Oct

- De – Thatch. (Remove a minimum of 60 – 80 bags)



- Aerate – Check depth of Compaction (50mm from surface – Hollowtine)
(Below 50mm - Verti-drain)

Aerate Verti-drain or Hollowtine



Verti-drain

Soil correction (Hollow tine) Rub into holes 20% compost mixed with sand. (No topsoil with mix)



Hollowtine



- Fertilise (Normally 50kg 5 : 1 : 5) Spread granules by Hand
- Water thoroughly. (Soak green to root level)
- Top Dress and Correct Levels



Spreading with T – Bar



Screed Rail



Levelling Rails

THATCH

Thatch is a concentrated layer of organic matter between the soil and the green surface.

This layer creates a cushion which not only slows down the green, but harbours fungi and unwanted insects. It can also become impervious to water.

All this will impede the emergence of new leaf growth through the mat.

Thatch becomes a problem when it exceeds 10 mm. This accumulation of thatch can create an environment that affects sward quality in many ways:

- Excessive thatch can create a favourable environment for many pests and diseases.
- Thatch can influence water movement in and around the grass plant.
- Thatch can alter soil surface conditions, often producing a waxy layer that can prevent water movement into soils (dry patch).
- Thatch can influence soil temperatures.
- Thatch interferes with air movement around the grass plant.
- Thatch can affect mowing quality.
- Thatch can prevent effective use of chemicals and fertiliser applications.
- Excessive thatch affects ball pace, ball bounce and ball roll.
- Thatch will also affect the traction and shear strength of the turf surface.
- Thatch will affect turf grass quality.

Mechanical removal of thatch

- The method and type of machinery used will be dependent on:-
- Depth of operation.
- The amount of thatch to be removed.
- Surface damage.
- Retention of organic matter.
- At renovation a Scarifier is used to remove thatch. On a normal size green one would remove anything between sixty and eighty barrows of thatch.

General

- The commonly accepted time for thatch removal is during the end of season renovations. However, with the development of groomers and verti cutting units on mowing machines thatch removal can be undertaken on a regular basis. In bowls situations these units are often used on a weekly or fortnightly basis.
- The other recognized time is in the spring, but generally involves a lighter scarification to minimise any damage to the playing surface ahead of the new playing season.
- Be careful not to overdo the scarification. Using a vigorous machine on a fine turf may have a detrimental effect.

MACRO THATCH

- This is a term used for the accumulation of dead material in the root zone. Often as a result of compaction, the soil becomes acidic and prevents the breakdown of organic matter, leaving undecayed matter in the thatch. If the greenkeeper has been top dressing on top of existing growing grass this becomes thatch in the root zone.
- Apart from slowing down the green this macro thatch can significantly interfere with the healthy development of roots and grass.

Macro Thatch



SCARIFIER

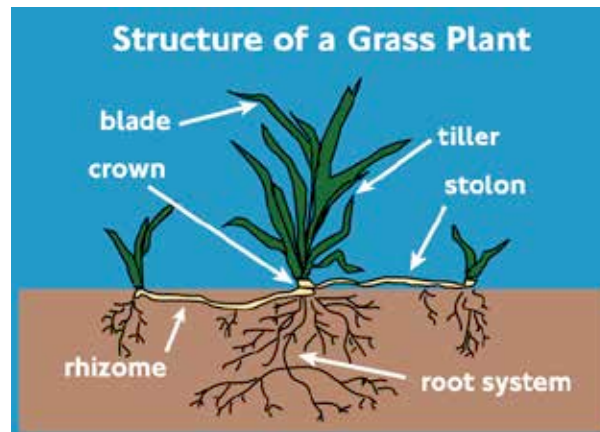


Prior to the use of a scarifier, one must check the root system is not too shallow and can be damaged by the blades penetrating the surface.

PIN SCARIFIER



GRASS



Introduction

The grass family contains over 5000 species, but only a minority of these is used for sports surfaces. To enable identification to occur between grass species, a form of classification has been produced based on botanical features.

The scientific names of many turfgrasses have been written in Latin and are based on a binomial system which was originally devised by the Swedish botanist Linnaeus in 1753.

Stolons

Surface creeping stems are termed Stolons and plants bearing them exhibit a stoloniferous mode of growth. Such stems root at the nodes (joint like sections) and also produce foliage at these points.

Rhizomes

Underground stems are termed Rhizomes and turfgrasses exhibiting these are termed rhizomatous. The stems occur at the base of the plant and bear scale leaves which produce rhizomes which will eventually reach the soil surface.

GROWTH

Grass grows as follows during the year:

- **October:** Ground Temp Below 18deg. Roots are still dormant but some leaf growth takes place relying on stored carbo-hydrates.
- **November:** Ground Temp Above 18deg. Good root development with good leaf growth.
- **December, January, February:** Full development of the plant.
- **March:** Temp dropping to 22deg and below. Root activity resumed as in Nov and whatever damage was done in the warm months is repaired. Leaf growth is sustained.
- **April – May:** Root expansion stops as ground temperature drops below 18deg although the roots are still active absorbing water and nutrients. Leaf growth slows down.
- **June – July:** Ground temperature no longer significant. Leaf growth virtually stopped but still produces carbo-hydrates. Roots still active.
- **August:** Roots still active and storing Carbo-hydrates in the stems and bulbous roots. Vertical leaf growth is resumed.

- **September:** Roots suddenly retract known as Root Die Back. No hair roots are observed as roots are inactive. Vertical leaf growth is increasing even in frosted areas. No carbohydrates are being produced.

PHOTOSYNTHESIS

Like humans, turfgrass needs food to grow and maintain life processes. Green plants are unique because they have the capability of manufacturing their own food from two simple raw materials, carbon dioxide and water. These low energy compounds are built-up, or synthesised into an energy rich plant food sugar known as glucose. This synthesis or “putting together” of plant food uses radiant energy from the sun as its energy source (photos, light + synthesis, putting together).

The only other prerequisite for photosynthesis to occur is a green coloring matter known as chlorophyll. This material is directly responsible for giving grass its characteristic “green colour”.

Carbon Dioxide (CO₂) + water (H₂O) + sunlight = photosynthesis.

When this process is completed the plant in turn releases OXYGEN back into the atmosphere. (Actively growing grass on a 50 x 50ft patch releases enough OXYGEN to meet the needs of a family of four, day by day. By tilling which is cutting, grooming and brushing correctly one creates more leaves.

This is good for the formation of the mat and healthier grass.

ROOTS

In order to maintain vigorous growth in turf grass on a bowling green the root system must be able to absorb and provide a regular supply of nutrients to the leaves.

The root system will regulate its own size, depth, and density according to the following:

- The demand for nutrients.
- The supply of nutrients available in the soil around the roots.

Demand.

A vigorously growing plant with a large leaf area would demand all the nutrients it can possibly obtain. If the demand should diminish because the greenkeeper has reduced the mowing height to the extent that the leaf area does not require so much food then the root system will retract. (This illustrates the relationship between the mowing height and the extent of the root development.)

Other factors which influence the size of the root system.

- The texture of the soil (The roots are there to absorb the processed fertilisers and will only reach down into the soil to a depth where the conversion of the fertilisers takes place, i.e. as far as the air can reach).
- Soil with larger particles will enable the water and air to penetrate deeper than in finer textured clayey soils.

Sandy soils = Deep roots.

Clay soils = Shallow roots.

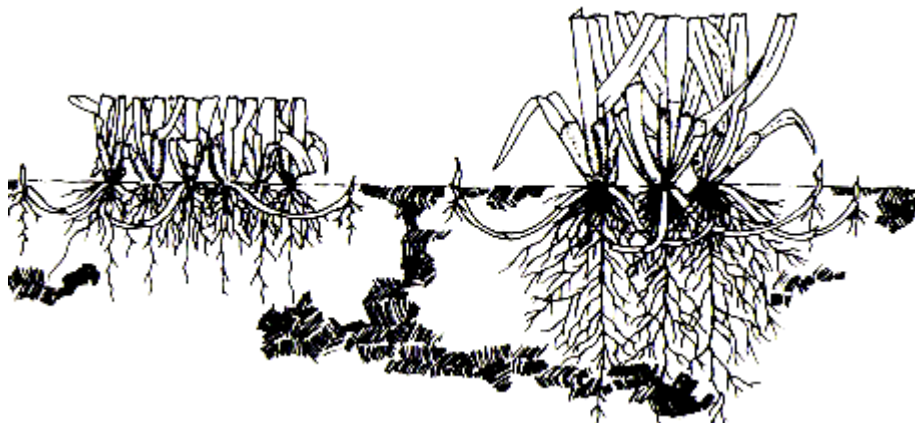
NB The greenkeeper must encourage deep rooting.

Shallow rooting

- Heat scald can take place.
- Compaction will reduce root growth.
- Fungi, disease and pest can cause a reduction in growth.

SHALLOW ROOTS

DEEP ROOTS



SOIL & TEXTURE.

It is important to know the texture of the soil on a green as this may have to be rectified at renovation time, or when a green is being constructed.

A particle size analysis report is available to the greenkeeper and this should be carried out every 4 to 5 years.

Soils for good turf growth should consist of:

- **Good infiltration rate.** Grass roots grow in-between particles of soil and use the soil to bind onto.
- **Good drainage.** Too much water held around the roots results in starvation of oxygen causing damage.
- **Good aeration.** Aeration depends on the air spaces between the particles as well as nutrients to pass freely in these spaces
- **Adequate moisture and nutrient retention.** Depending on the texture of the soil nutrients and water are stored between these spaces enabling the plant to obtain food over a period of time.
- **Absence of compaction.** When particles of soil are too fine they bind together more easily and form compaction, thus resulting in poor drainage

Compaction

Mainly occurs 35mm to 50mm in depth to the surface layer. This must be dealt with immediately by means of drilling, hollowtining or verti-draining. Aqua-jetting is another method but is not advisable in certain soils.

Forces exerted on a green.

- | | | |
|-----------------------|---|------------|
| • Standard mower | = | 2kg/sqcm |
| • Roller 1,8m (water) | = | 2kg/sqcm |
| • Bowler | = | 5,7kg/sqcm |
| • Roller polisher | = | 0,7kg/sqcm |

It is important to know that certain microbes are to be maintained in soil or damage will occur.

Soil Sterilisation

It is important to ensure that soil placed on the green is sterilized before use as unsterilised soil will bring in foreign grass and weeds.

It is advisable to order topsoil and river sand approximately 4 to 6 months ahead of renovation period. Once the ratio mixture of topsoil and river sand has been established the soil can be mixed and once this has been completed it must be sterilised.

To sterilize soil the following methods can be done:

- Lay the soil out on a firm base approximately 100mm thick, now wet the soil and immediately pour Herbifume on with a watering can then cover with Crop Guard cloth for fourteen days. (This method is expensive)
- Lay soil on firm base where it will receive good sunlight. Wet the soil and immediately cover with a black plastic sheet. Leave for ten days and then remove all dead foreign matter. Repeat this for another ten days to ensure all foreign matter is killed. Before repeating turn soil. (This is a cheaper method)

- Another method is once the soil is spread 100mm a good fire may be made on top which will burn all foreign seed remaining in soil.

Soil sampling

1. Remove at least six cores from a green.
2. Mix all samples from one green in a container and place in packet

Understanding what is going on below the surface is critical for successful turfgrass management. Visual inspections, backed up with a professional analysis of soil properties, will give vital information about the condition of the soil and help to produce a more productive environment for plant growth and sustainability.

A simple 'visual, feel and smell' inspection of a soil sample can identify many things:

- Thatch content (dead grass and fibre found in the top 5-35mm of the sample)
- Dryness/wetness of soil (soil water content)
- Soil compaction (lack of airspace in the soil)
- Presence of black layer and algae
- Anaerobic conditions (indicated by a smell similar to rotten eggs)
- Extent of soil layering (indicated by root breaks)
- Root depth and vigour
- Pest and disease problems

The easiest way to make this inspection is by using a soil sampler..

On a basis (at least once a year) soil samples should be collected and sent away to a laboratory for a detailed analysis. The testing can reveal a lot of important data to help you diagnose any problems and to make an informed decision on future maintenance regimes.

The following five soil tests are the ones you should be aware of:

Particle Size Distribution (PSD) soil classification (soil type)

- Soil pH (acidity level of the soil)
- Soil nutrient status
- Soil Organic Matter (OM) content
- Soil Toxicity

Do not sample within a month of fertilising.

GREEN SPEED.

There are two major factors which influence the speed of a bowling green:

The soil base needs to be firm without being compacted. If too compacted the grass does not grow, or too soft the bowl sinks in and has a greater rolling resistance. Therefore a balance must be kept.

When mowing to achieve the ideal speed the following should be observed:

- Cut daily or at least 5 out of 7 days.
- Never mow lower than the recommended height for the grass in use.
- It is better to support the mowing regime by verti-cutting.
- Never mow when the grass is wet.
- Always double cut.
- Grooming removes thatch and thins out the mat to speed up the run of the bowl.
- When the grooming cut is being done in the growing season, an occasional light rub-in of soil the same size as the top dressing will help smooth the green.
- Should the green have different types of grasses the greenkeeper must rectify these areas with the best possible method available to him, so as to enable the green to be used at the shortest possible time again.
- This should be carried out before spring treatment so as to achieve good mat development after spring treatment.

A green is timed over 27m, this being the area most affected by play.

Causes of resistance to the bowl

- Hardness of the base.
- Thickness of the mat.
- Mowing height.
- Characteristics of the grass.
- Grooming prior to tournament, never groom two days prior to tournament. Grass will have dry ends on stems, effecting speed.

FERTILISER

When a green is fertilised with granules an even spread must be obtained across the entire green and on the banks. This should only take place when the grass is dry and must be watered in immediately. Should the grass be damp when applying granules leaf burn will occur. Another method is to soak the granules in water overnight and then spray on by means of a venturi nozzle connected to the hosepipe.

Liquid fertilisers are also available which can be sprayed on by hosepipe or knapsack.

AFTER FERTILISER IS APPLIED SOAK GREEN TO ROOT LEVEL.

Nutrients required by turf grass.

- Macro nutrients.
- Micro nutrients.

Major:

N = Nitrogen.

P = Phosphorus.

K = Potassium.

Secondary

S = Sulphur.

Ca = Calcium.

Mg = Magnesium

Micro nutrients

Heavy metals:

Fe = Iron.

Mn = Manganese.

Zn = Zinc.

Cu = Copper.

Non metals

B = boron

Beneficial nutrients

Na = Sodium

Al = Aluminium.

Fertiliser program

A balanced fertiliser program must be compiled for the duration of one season.

- When LIME is applied to a green one must exercise care not to use NITROGEN too soon as this will create ammonia gas on the surface which could be fatal.
- Records must be kept at all times of work and chemicals used on the green and surrounds.
- To ensure that a program is to work correctly pH levels are to be checked on a regular basis to ensure the correct balance is kept.
- Fungicide should be sprayed separately to the program as when added it tends to push up the acidity level at the time of application.
- It must be remembered that towards the end of the growing season the amount of POTASSIUM should equal that of NITROGEN.

Nutrients removed from a bowling green producing 1,1 to 1,4 tonnes dry matter per annum will use the elemental state approximately:

Nitrogen (N) 50 kg
Phosphate (P) 3 kg
Potash (K) 35 kg

Uptake of other macro-elements Sulphur (S), Calcium (Ca), and Magnesium (Mg) are more or less in the range of P. The main micro-elements Zinc (Zn), Boron (B), Molybdenum (Mo), Iron (Fe), Manganese (Mn) and Copper (Cu) are used only in very small quantities.

To determine the quantity of N, P and K in a bag i.e. 5 ; 1 ; 5 (36)

Add the figures on the bag, $5 + 1 + 5 = 11$

$36 \text{ divide by } 11 = 3,3\%$

$N = 5 \times 3,3 = 16,5\%$

$P = 1 \times 3,3 = 3,3 \%$

$K = 5 \times 3,3 = 16,5 \%$

pH IN SOIL

(Potential of HYDROGEN)

Good soil contains about equal parts of mineral matter in the form of sand, clay and organic matter. Even a soil which is structurally well balanced may be too acidic or too alkaline. An extreme either way will inhibit plants from absorbing all the essential nutrients which makes them grow successfully.

The acidity or alkalinity of soils is measured on a pH (potential of Hydrogen) scale.

A soil with a pH of 7 is neutral. Any reading below 7 is acidic and above 7 is alkaline.

The pH range for good grass growth on most soils is between 5.5 and 7.0 with 6.0 being ideal for most plants.

Managing Soil pH for Turfgrasses

The amount of annual rainfall largely determines whether soils will become acid, neutral, or alkaline. In regions of high rainfall, the alkaline elements in the soil are slowly replaced by hydrogen ions from the water and are leached deep into the lower horizons of the soil. This weathering process leads to the development of an acid soil. Conversely, soils which develop under conditions of low rainfall, tend to become alkaline. The use of certain fertilizers, acid rains, and clipping removal of the alkaline elements also contribute to the development of soil acidity.

Lowering Alkaline Soil pH

Apply Aluminium Sulphate, finely powdered sulphur or specific fertilisers which increase acidity such as Ammonium nitrate or ammonium sulphate

Raising Acidic Soil pH

Apply Dolomitic Lime.

TURFGRASS DISEASES AND PESTS

There are somewhere in the neighbourhood of 100 different diseases that affect turfgrasses. Just like human illnesses, each turf disease has a specific prescription for its cure and prevention. Some diseases can be suppressed by the application of nitrogen fertilizer, whereas others are encouraged by more nitrogen. Some diseases are suppressed by high soil pH, whereas others are encouraged by low pH. A long list of other turf management practices can be used to control disease, but the most effective prescription is specific for each disease.

IDENTIFICATION

Turfgrass diseases are very difficult to identify. Grass plants are very small, and most diseases are caused many microorganisms that can't be seen without a microscope. However, with some basic knowledge and a lot of practice, you can vastly improve your diagnostic skills. By learning how to diagnose just a few common diseases, you will be able to diagnose most of the disease problems that you encounter during the season.

Diseases may produce *spots*, *circles*, *patches*, *rings*.

Some diseases produce an *irregular* or non-patterned symptom across the turf.

Generally, the best plant symptoms can be observed along the border between healthy and diseased turf. The plants in severely affected areas that are already dead are not very useful for diagnosis of turfgrass diseases.

Symptoms observed on individual plants include *leaf spots*, *foliar lesions*, *stem lesions*, *foliar blight*, *foliar dieback*, *crown rot*, and *root rot*. A *leaf spot* is a round or oval area on the leaf with a distinct border, which is usually a different colour than the centre of the spot.



LEAF SPOT

A *foliar lesion* is irregular in shape and is typically larger than a leaf spot, but still has a distinct border that is usually a different colour.



FOLIAR LESION

A *stem lesion* is very similar to a foliar lesion, but is present on the stem or leaf sheath of the grass plant rather than on the leaves.



STEM LESION

Crown rot is observed as a dark and rotten area at the base of the turfgrass plant.



CROWN ROT



ROOT ROT

Root rots produce a visibly dark and rotten root system, and also a noticeable reduction in root depth in affected areas. Crown rots and root rots often occur together, and may also include rotting of stolons and rhizomes if present.

Signs are the visible evidence of the presence of a pathogen. Most turfgrass diseases are caused by fungi, and even though fungi are microscopic organisms, some produce larger structures at certain times in their life cycle that can be seen with the naked eye. *Mycelium* is a cottony or spider-web-like mass of fungal growth that certain fungi produce when the turf is wet or humidity is high.



MYCELIUM

Spore masses are fuzzy or jelly-like growths produced on the diseased tissue by certain fungi, again usually when the turf is wet or humidity is high.



SPORE MASSES

Sporophores are enclosed structures that contain fungal spores. Often seen as small, dark specks on the diseased tissue.



SPOROPHORES

Sclerotia are small, round, hard structures produced on the diseased turf or in the thatch layer by certain fungi. Sclerotia are actually survival structures that some fungi use to survive through periods of unfavourable weather conditions. Most people are familiar with *mushrooms*, which are the large spore-producing structures produced above-ground by Basidiomycete fungi. Some turfgrass pathogens, most notably the fairy ring fungi, produce mushrooms as a sign of their presence.

FUNGI

Fungi are the main cause of infectious diseases in turfgrasses. These are small microscopic organisms, ranging from 0.5um to 100um in diameter, that lack chlorophyll, are non-green plants that do not produce true seeds and whose bodies lack true roots, stems and leaves.

The body of a fungus is a very simple structure. It is either made up of a single cell or a series of cells (multicellular) arranged linearly into tube-like strands. These individual strands or filaments are known as hyphae. These hyphae have well developed walls, cytoplasm, nuclei and reproductive systems, which is typical of plant cells. They contain their genetic material inside the nucleus. The hyphae of most fungi are divided into cells by cross walls (referred to as septae). Some species of fungi, such as members of the genus PYTHIUM and PHYTOPHTHORA do not have septae and these are referred to as non-septate. A mass often develops and this is known as mycelium.

FUNGICIDES

Systemic fungicides

These work best during periods of active grass growth and include Benlate, Bounce & Tecto. These products are absorbed by grass roots and leaves and move into the sap, can control diseases for 4 to 6 weeks, are more specific than contacts and are more likely to cause resistant strains than contacts.

Contact fungicides

They work at all times of the year including cooler months when there is less active growth. These include Copper, Dithane, Bravo & Rovral.

These work through the soil into roots which distributes to plant and will last 10 – 14 days.

Disinfectants

Jeyes Fluid, Jik and Potassium Permanganate are powerful bactericides/fungicides but are instantaneous in action and have no residual effect. Jeyes and Jik are normally used at a concentration of 1%(1 litre/100 litre water) and sprayed in the cool of the day to avoid scorch. Also useful for disinfecting implements, and machinery being used on greens with fungus infections.

Always spray fungicides in early morning

ALGAE. [*Cyanobacteria*]

SYMPTOMS

Although they do not infect grasses, blue-green algae are a significant pest problem in the turfgrass industry. These organisms contain chlorophyll just like plants, but they grow by producing chains of thread-like cells similar to fungi.



Algae may develop whenever thinning of the turf canopy permits sufficient air, light, and water to reach the thatch surface. Algal growth is most aggressive during the late spring, summer, and early winter when warm, humid conditions are conducive to algae growth and turf thinning. Low mowing heights, shady conditions, poor soil drainage, and frequent irrigation also encourage algal growth in the turf canopy.

Once Algae is present, the surface area must immediately be disturbed and aerated. Jik may then be sprayed onto the area at 100mm per 10l water. When dry crust is formed this must be removed.

DOLLAR SPOT.

(*Sclerotinia homoeocarpa*)

Symptoms

Small, circular spots 20mm – 70mm in diameter develop over several days on turf. The grass in the spots may be killed on the soil surface and the spots become depressed if the disease continues to develop. Lesions on leaves are light tan and often have a dark margin at the edge when the disease is spreading.



Mycelium for Dollar Spot



Spots on green

Control

Cut grass low. Adequate nitrogen fertilization and soil moisture levels will help prevent the development of Dollar Spot. Removal of dew as early as possible will help reduce the risk of the disease developing.

Many fungicides are available that will control the disease.

FAIRY RINGS.

(*Marasmius* sp, *Lepiota* sp, *Psalliota* sp.)

Symptoms

Fairy rings may appear as small to large rings of very green grass, dead grass, mushrooms or puffballs with little effect on the grass or as combinations of these symptoms. The soil in the rings may become very dry and is difficult to wet during the summer and fall. Symptoms in a particular fairy ring may change throughout the year. Mushrooms or puffballs are present in the late summer and winter. These fruiting bodies may never appear, or may appear only in certain years.



FAIRY RING

Control

The removal of excess thatch and the use of management practices to prevent excess thatch accumulation may help prevent them from developing in established turf. Irrigation to keep soil moist may prevent the development or severe damage from fairy rings.

RED THREAD DISEASE

This disease occurs during spring and autumn on slow growing and nitrogen deficient turf. Circular or irregularly shaped, small to large patches (5 – 50cm in diameter) of infected grass become water-soaked and die rapidly. The tan colour of dead leaves may be the first symptom observed.

When the air is saturated with moisture, pink to pale red fungal growths, called red threads, may extend up to 10mm beyond the end of the leaf tip. Pink cottony flocks of mycelium up to 10mm in diameter may also be produced.



Control

Maintain adequate and balanced fertility, based on soil test results. Applications of nitrogen are particularly helpful in reducing disease severity, but excessive rates must be avoided.

PYTHIUM BLIGHT
Pythium aphanidermatum

Pythium blight first appears as small, sunken, circular patches up to 1 foot in diameter during hot, humid weather.

Leaves within the patches are matted, orange or dark gray in colour, and greasy in appearance.

Gray, cottony mycelium may be seen in the infected areas when the leaves are wet or humidity is high.

The disease spreads rapidly along drainage patterns and can be tracked by equipment. This disease can spread rapidly and cause severe damage to a green very quickly when conditions are favourable for development.

Control



Avoid over-fertilization with nitrogen. Use slow release forms of nitrogen when possible.

INSECTS.

There are two species of insects that are found around our greens in the R.S.A., insects harmful to plant life and beneficial insects.

Effective control

To effectively control insects it is important to understand them better. Because insects are cold-blooded, the outside temperature regulates everything they do. Their hard external skeleton (exo-skeleton) also becomes resistant to chemicals.

Their development or metamorphosis takes place in the following sequence: egg, nymph and adult. For an insect to grow, it has to shed skin (moult). Some pesticides disrupt this moulting process.

It is important to note that if you use IGRs when the insect is in the mature state, you are wasting time and money.

One has to create an environment to cope with insects such as;

Thatch management - the more thatch you have the more insects there will be.

The three most important factors in insect control are:

- Selection of product.
- Technique
- Timing – most important.

There are two groups of insects:

- Above ground, e.g. caterpillars.
- Subterranean insects, e.g. mole crickets.

They are protected by the soil around them. It is difficult to get the insecticide to the subterranean insects. When the soil is dry, subterranean insects move down into the ground because they need a reasonable measure of soil moisture. If there is dry organic matter, the insecticide tends to stick to it.

There are two options:

- A. Heavily irrigate the area so that the grubs move up and then apply the insecticide and irrigate afterwards.
- B. Wait until you get good rain, because though the grubs are larger, they are then closer to the surface.

PESTICIDES

The challenge for greenkeepers is to move to the newer pest control systems as they must realize that they are in control of a living eco – system.

Pesticides should only be used when and where they are needed.

Insecticides penetrate insects in three different ways, through the outer covering (skin), through the mouth, or through the breathing holes (spiracles). These are termed contact poisons, stomach poisons and fumigants respectively.

NEMATODES

Symptoms

Damage to roots is the most important effect of nematodes on turf grasses. Roots may be killed or stunted, resulting in poorly developed, shallow root systems. The above ground symptoms are slow growth, thinning of the turf, poor response to adequate fertilization and irrigation, rapid wilting during dry weather and weed invasion. Nematode assay of soil samples is the only sure way of determining if nematodes are a problem since other diseases or nutritional problems may produce similar symptoms.

Factors affecting development.

Nematodes are most damaging in light, sandy soils which are low in nutrients and water holding capacity. Proper irrigation and fertilization practices will often overcome the effect of some types of nematodes.

The type and number of nematodes present in the soil must be determined before they can be identified as a problem.

Nematode levels are usually lowest in Spring and increase to the highest levels in winter. Winter is a good time to have soil samples assayed for nematodes.



Control

Good management practices will help overcome the effect of many nematodes and are the only practical means of control on low maintenance areas. When the sting nematodes are present, nematicides are usually needed on highly maintained areas.

Crop Guard - Used per instruction.

Dark Brown sugar or Molasses added to fertiliser drum.

10 kg Dark Brown sugar.

10lt Molasses

BLACK MAIZE BEETLE.

The black maize beetle, affects a wide variety of crops and grasses. Symptoms are sometimes confused with cutworm damage. These beetles seem to favour cooler areas and sandy soils.

Lifecycle



Control:

There is no definite cure as such but hollow-tining and the use of strong insecticide can help control these beetles.

Spraying Insecticide in the latter part of the day is best as this is when they start to surface.

The grubs under the soil are the ones causing the damage by sucking the sap from the root.

CUT WORM



If you see a lot of moths flying around at dusk it is an early indicator that you will have caterpillars in a week or 10 days.

ARMY WORM



- If there are a lot of birds on turfgrass it is an indication that there are caterpillars.

SOD WEBWORM



ADULT



Mark on Green

WEEDS

POA annua (Winter grass)

Winter grass is a cold grass species found on majority greens.

Winter grass is a winter annual that germinates in the late summer/early winter once soil temperatures fall below 22 degrees Celsius.

Seedlings mature in a vegetative state and produces seed in late spring and early summer.

An individual plant is capable of producing more than 360 viable seeds. The seeds may lie dormant in the soil for many years before germinating.



Cultural Control

- Avoid nitrogen and phosphorus applications when plant is germinating.

Chemical Control

Chemical control can be attempted with growth regulators, pre-emergence and post-emergence activity.

KERB is commonly used as pre-emergence at a quantity of 280grams on two applications over two months.

As a post-emergence Kerb is used by means of applying 470grams per green.

KERB is not suitable on certain grasses (i.e. Otiniqua grass) CHECK before use.

LAWNTYL is also used at 30ml per Knapsack. Do not try to increase dosage for faster results as damage to the grass will occur.

CLOVER AND SORREL



When you want to treat this weed, use a post emergent herbicide containing the active ingredient fluroxypyr. Follow instructions carefully if you apply it to your green.

CARROT WEED



The best time to control wild carrot weeds with herbicide is when they are young and in their basal rosette stage. Wild carrot can be quite resistant as it matures and therefore you may have to conduct repeat applications. If all else fails and the wild carrot is not taking to any of these herbicides, you may have to resort to Roundup to get a guaranteed elimination of the plant.

- Use a hand-pump sprayer with a fan tip nozzle. Spraying a fine mist is best when applying Herbicides to wild carrot.
- Remember that the label is the law. Be sure to look towards the instructions on the label for proper application and mixing rates.

CONTROL

Weed killer 2: 4: D (DICAMBA) herbicide is an industrial weed killer for control of broadleaf weeds in grasses. It is a systemic post-emergent herbicide and is safe for use on most grasses.

PESTICIDES SPRAYING RATES

SYSTEMIC FUNGICIDES

TYPE	PER GREEN	PER 10L WATER
Banner [Dollar Spot, Brown Patch]	285ml to 500ml per green	50ml
Benomyl [Dollar Spot etc.] Fairy Ring	400grams 1kg +80ml Breakthru with 50 liters (Water in well)	65grams
Bumper[Dollar Spot, Spring Dead Spot]	500ml per green	50ml
Heritage [Broad spectrum]	80 to 160grams.	20grams

CONTACT FUNGICIDES

TYPE	PER GREEN	PER 10L WATER
Bravo [Dollar Spot]	700ml	50ml
Mycoguard 720	700ml	50ml
Daconil	500 to 750ml	50ml

INSECTICIDES

TYPE	PER GREEN	PER 10L WATER
Meridian – White grub, Mole Cricket	160grams	16grams
Kemprin 200 EC – Black Maize, Caterpillars	50ml	5ml
Sneak - (Broad Spectrum)	200ml	20ml
Karate - (Broad Spectrum)	50ml	5ml
Kohinor – Ants, Ground Pearl etc	50ml	5ml
Crop Guard – (Nematodes)	7 to 10lt (Follow up with 4lt over 4 Intervals)	
Merit – Ants, Mole Crickets & Beetles	125ml	12.5ml
Carbofuran – Earth Worms	5kg	
Regent – Ants and Other	30ml	

HERBICIDES

TYPE	PER GREEN	PER 10L WATER
Super Lawn – Broad Spectrum	285ml	25ml
Turfweeder - Broad Spectrum	285ml	25ml
Hormoban – Broad Leaf	300ml	30ml
Gramoxone – Paraquat -	Wintergrass,	16 to 30ml
Simanex -	Wintergrass	410ml water in well
Lawntyl	Wintergrass	30ml per knapsack

WETTING AGENTS

TYPE	
Break Thru	0,5ml per liter water
Villa	1,0ml per liter water

ALWAYS READ AND FOLLOW INSTRUCTIONS ON ALL PRODUCTS

EVALUATING A BOWLING GREEN.

BANKS and DITCHES

Comments Only

The banks, ditches, pegs, numbers and surrounds are all an integral part of the game of bowls but do not directly reflect the health of the grass or the playing surface.

Banks .

Grass Banks

Uniformity on all four sides is the primary consideration.

Same Height and Angle.

- The grass making up the bank must be healthy with no bare patches or weeds intruding.
- The upper edge must be straight and not rounded.



ROUNDED BANKS

- The top of the banks should be, at least, 230mm above the surface of the green
- The banks can be vertical and set at 90 degrees (Artificial only) to the surface of the green or have a slope of not more than 35 degrees off the vertical. Grass does not grow properly on a 90 degree.
- Banks must not be undermined as this could cause injury to a player when standing on the edge.



UNDERMINED BANK

Artificial Banks

The main consideration being how often a bowl would rebound.

There must be uniformity in their appearance and in the standard of maintenance. Belting should not be loose or create unevenness in ditch width.

Pegs or Straps**Comments Only**

Pegs must conform to the Laws of the Game and must be correctly positioned on top of the bank (not more than 100 mm from the face of the bank) or flat against the bank. The pegs or straps should not be more than 25mm wide.

Pegs will be placed on top of the bank while straps will be positioned against the bank.

Anything placed against the bank must not be of a material which might injure or divert the bowl or jack, this includes the fasteners.

They must clearly define the boundaries of the rink or the 25m mark.

Ditches**Comments Only**

The ditches can be between 200 mm and 380 mm wide.

The ditches can be between 50mm and 200 mm deep.

Within the above limits there must be uniformity re; depth and width on all four sides. It is accepted that as a result of regular top-dressing the surface of the green will rise in relation to the ditchboards.



Too much grass above board

If the ditch board is more than 10 mm below the surface of the green the boards must be lifted, as the grass surface becomes spongy and could cause bowls to fall into the ditch.

Ditch Surface ,

It must be a holding surface.

The inspector must roll a Jack manually or off a short stimpometer from a point 2.00 m from the ditch and at an angle of 45 degrees to the ditch to establish how freely the jack would run in the ditch.

The inspector should comment on this in the appropriate space.

Uniformity of Ditch



Mat at bottom creating unevenness

COMMENTS

Although no marks are awarded in this section the Inspector must still be assured that, within the parameters of the Laws of the Game, there is still uniformity as far as the Banks and Ditches are concerned and that the equipment is not only adequate but well maintained and correctly adjusted.

SUB – SECTION B

100 Points

In Section “B” Each item will be scored on it’s own and the grand total will serve as a reflection of the GKP’s ability to produce and maintain a green of the required standard. While it must be acknowledged that a GKP often “inherits “ a green with inherent deficiencies (Levels and Foreign grass) which might preclude him from attaining top marks the other results will reflect his ability to overcome these deficiencies.

THE GREEN SURFACE

A GKP is expected to provide his members with a playing surface which is completely covered by a mat of even thickness throughout which allows the bowl to run at an acceptable speed without compromising the health of the grass – a balancing act between “leaf area” and speed.

GRASS COVER

Any area on the green where the mat varies in thickness or there is a limitation of growth either because the growth is sparse compared with the rest of the green or where there is no growth at all.



FULL COVERAGE

BARE/WEAK AREAS

TOTAL 10 Points

If there is evidence that the GKP has re-planted a bare area or is nursing a weak area the Inspector can be more lenient but must take into consideration how long the area will take to restore.

Points are deducted according to –

- the size of the weak or bare areas and the influence such an area might have on the behavior of the bowl (a bowl will run faster over a weak or bare area)



WEAK AREA



BARE AREA

MAT THICKNESS

TOTAL 10 Points

Points are deducted according to –

- variations in the thickness of the mat due to grasses of different texture.(Heinz Green)
- Spongy affect due to not de – thatching.



TOO MUCH THATCH

FOREIGN GRASS

TOTAL 10 Points

Points are deducted according to the severity of the different types other than the predominant grass species.

Deduct Points if;

- Variations in the thickness of the mat due to grasses of different texture. (Heinz Green)
- Incorrect management of foreign grass areas in relation to predominant grass.

1.5 APPEARANCE

TOTAL 10 Points

- The player would prefer to play on a green of the same colour throughout.
- A mottled green where there are dark patches interspersed with lighter patches can cause doubts in the mind of the player regarding the consistency of the surface.



MOTTLED SURFACE

- Evidence of bad mowing techniques with uncut areas or shaving of the green should, also, be penalized.

Deduct Points if;

Colour of green –

- If there are various patches of different colour on the green.

Texture

- If there are thicker patches alternating with patches where the covering is sparser giving a patchy appearance (whatever the reason)

Overall Impression

- If there are bare patches, re-sodded areas, mower lines, anything jarring the senses.



FAIR APPEARANCE



BAD APPEARANCE

SMOOTHNESS (To be tested with a jack)

TOTAL 10 Points

The jack is delivered from corner to corner to check for bumps.

Bumps - Depending on Severity - **Deduct Accordingly**

RUN – OFF

TOTAL 10 Points

A bowl increasing it's pace as it draws near to the ditch and inevitably falling into the ditch is most annoying to a bowler. As it is something which can easily be averted the Green keeper must be marked down.

A Spirit level is to be used to determine runoff.

Run Back may occur when ditchboards have been lifted, and must not be too severe.

For each side where run-off occurs –

Deduct 2.5 points

COMPACTION / ROOTS

Comments Only

The inspector must use a probe to determine whether there is any compaction hindering the penetration of the probe. Compaction found on surface down to approximately 40mm will prevent nutrients, air and water from reaching the roots. Below 40mm compaction will be in the root area.

PESTS

INSECTS

If there is evidence of the green being invaded by insects, points must be deducted accordingly.

If the GKP has already initiated treatment the inspector can be more lenient.

- Deduct 1- 3 points

WEEDS

If there are weeds present points must be deducted accordingly.

The inspector can be more lenient if there is evidence that the weeds are being treated and the normal grass is gaining on the weeds. –

Deduct 1 – 3 points

LEVELS

TOTAL

30 Points

The Level Profile

No Inspector or Club Committee can assume that there are no inconsistencies in the draw unless he has access to a level profile.

A recent BSA level profile (3 years old or less) submitted by a competent person (i.e. a person approved by the District Greens Committee) is the only complete tool available to verify the consistency of the draw over the whole green. By taking note of the variations in levels it is possible to decide whether they would affect the draw or not.

The Levels to be taken at 2.0m intervals over whole green.

Acceptance for SA competitions

- All clubs applying for consideration for a SA competition must submit a recent levels profile of their greens with their application to the district.
- These profiles to be submitted to the SA Bowls Greens Committee prior to them visiting the district to carry out the evaluation.
- All BSA tournament greens - minimum of 16 points.
- HQ greens - minimum 20 points
- **Any club not submitting a BSA profile conforming to above will not be considered for the competition.**

After the inspector has checked the profile, it is of utmost importance that should the levels be in need of correction, to ensure a new profile is received after the corrections have taken place.

SPEED

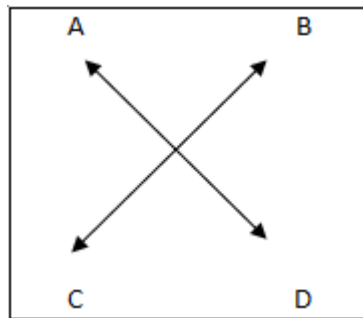
Comments Only

The speed of the green is tested by bowls rolled across the surface and timed over 27,5m or by means of the small stimpometer tested with a Jack as per Fig 1.



SMALL STIMPHMETER

Test Direction from center of green.



Equivalent Distances off a small stimphmeter to Seconds over 27.0m

3.50 – 3.85m	=	10.00 secs	6.20 – 6.60m	=	13.50 secs
3.85 – 4.20m	=	10.50 secs	6.60 – 7.00m	=	14.00 secs
4.20 – 4.60m	=	11.00 secs	7.00 – 7.50m	=	14.50 secs
4.60 – 5.00m	=	11.50 secs	7.50 – 8.00m	=	15.00 sec s
5.00 – 5.40m	=	12.00 secs	8.00 – 8.40m	=	15.50 secs
5.40 – 5.80m	=	12.50 secs	8.40 – 8.80m	=	16,00 secs
5.80 – 6.20m	=	13.00 secs	8.80 – 9.15m	=	16.5 secs



BOWLS SA GREENS EVALUATION SHEET



CLUB.....

DATE INSPECTED.....

GREENS			
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Legal Considerations - Comments

Banks

Height	At least 230mm above green surface	Acceptable	To Comply		Acceptable	To Comply
Angle		Rounded	Undercut		Rounded	Undercut
Top		Uneven	Good		Uneven	Good
Artificial	No metal or sharp edges on bank face.	To Secure	Rebound		To Secure	Rebound
Pegs	Clearly visible Width 25mm	Yes	No		Yes	No

Ditches

Width	200mm – 380mm	N/ Attention	Varies		N/ Attention	Varies
Surface	Jack to remain in rink	Soft	Hard		Soft	Hard
Depth	Min 50mm – Max 200mm	Acceptable	To Comply		Acceptable	To Comply
Boards to be covered with grass		Acceptable	N/ Attention		Acceptable	N/ Attention

Playing Surface

Green Surface - 60 Pts

Weak/Bare Areas		Small	Large	10			10	
Mat Thickness -	Not more than 10mm	Good	Poor	10			10	
Foreign Grass -	Areas managed correctly	Large	Small	10			10	
Appearance	Uniform	Mottled	Bad	10			10	
Smoothness -	Tested with Jack	Good	Bumpy	10			10	
Runoff	North East	South	West	10			10	
TOTAL				60			60	

Pests - 10 Pts

Fungi/Disease - If present must have been treated	Present	Nil	4		Present	Nil	4	
Insects	Present	Nil	3		Present	Nil	3	
Weeds	Present	Nil	3		Present	Nil	3	
TOTAL				10			10	

Levels - 30 Pts

No BSA Level Profiles – 5 Points only.

Profile -	Current - 1yr - 2yr - 3yr - Older	TOTAL POINTS 30			
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GRAND TOTAL	100			
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A + 100 - 90	A - 89 - 80	B + 79 - 75	B - 74 - 70	C + 69 - 65	C - 64 - 60	D - > 59
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Comments

SPEED	Must be between 12,5 and 14 secs					
DRAW	To be no less than 1m on both hands					
COMPACTION	Surface	Root Level	N/ Attention	Surface	Root Level	N/ Attention

COMMENTS

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INSPECTORS /

SURVEYING AND LEVELLING A BOWLING GREEN

- Definition of a survey – “To record the features (levels) of an area (green) in order to produce a plan (profile) of the area”.
- For an accurate profile, readings are taken at 324 predefined points over the green (36x36); predefined so that they can be plotted on the profile. Each point therefore has elevation as well as position – this is assumed in spreadsheet calculations.
- From the profile the level of any point on a green can be determined and it is easy if required to go back to any high/low points on the green.

Tools That You Need

- Dumpy Level and Staff – Check Dumpy
- Cord and 2 x 2 meter canes – Make Cord
- Clipboard, Pencil and copy of Survey Log
- PC/Printer with Microsoft Excel and Adobe Acrobat
Excel workbook – provided

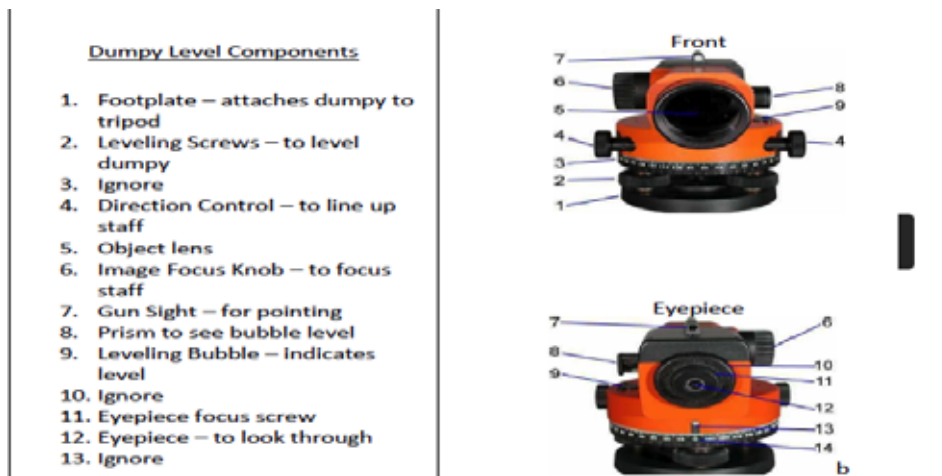
Skills That You Need

- Basic PC skills
- How to set up and take dumpy level readings
- To exactly follow survey process explained in write up
- To enter readings into workbook

What You Get

- All calculations are done by Excel
- BSA Level Points for green is calculated
- Profile of green printed by computer
- Levels of green are analysed
- Computer digital record of green

The Dumpy Level



Automatic Levels

- The Automatic Level is an easy to use surveying Instrument.
- Instrument needs only to be setup level within its circular level bubble.
- Has a damping compensator that adjusts line of Collimation.
- Generally accurate to +/- 2mm

The Damping Compensator

Modern levels will all use some form of automatic compensator, which allows the user to level the instrument with the circular bubble only. The compensator compensates any small departures from level.

In this device a fixed mirror passes the image through a prism that then deflects the image of the object, after which it is deflected by another mirror to the eyepiece. The prism is suspended by wires and any deviation from level is corrected .

The geometry of the device is designed so that any tilt of the telescope tube is compensated by a tilt of the prism and the collimation axis remains horizontal.

The compensator has a limited range (a few minutes of arc) and the level must be levelled reasonably well using the circular bubble before the compensator will work correctly.

Setting

Take care when setting up dumpy, work carefully and methodically. Do not remove dumpy from case until tripod is set up.

1. Open up tripod and extend legs to desired length, so that dumpy will be at eye level, tighten leg clamps. Place tripod in position where it will be stationed, balance legs and get top of tripod near level. Check that legs are in suitable position for taking readings, press legs firmly into ground.
2. Remove dumpy from case and attach to tripod using large screw in tripod, make sure dumpy is firmly attached.
3. Level dumpy using bubble; turn dumpy parallel to 2 foot screws, adjust level using these 2 foot screws, turn dumpy 90 degrees and level using 3rd foot screw. Bubble should be in centre of circle – if not repeat process until dumpy is level.
4. Look into eyepiece and focus cross hairs using adjusting wheel.
5. Test direction controls and use of gun sight for pointing.
6. Test image focus controls.

Stadia Reduction

Many levels have more than a Horizontal line in the telescope. These lines are called stadia lines. The middle horizontal line marks the horizontal plane through the telescope (height of collimation) and is the reference for all height readings. The other two short lines are stadia lines. Stadia are used for measuring the distance to the staff by multiplying the difference between the two stadia readings by a constant (usually 100).



In the view below the staff reading is 2.993

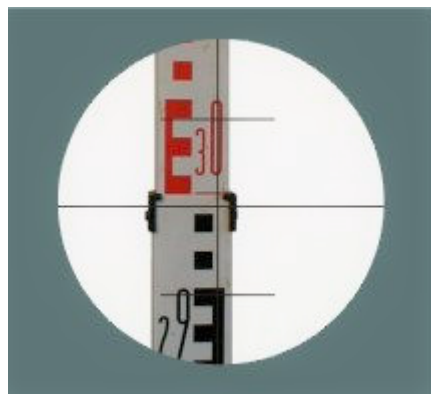
Upper stadia = 3.040

Lower stadia = 2.946

Stadia difference = 0.094

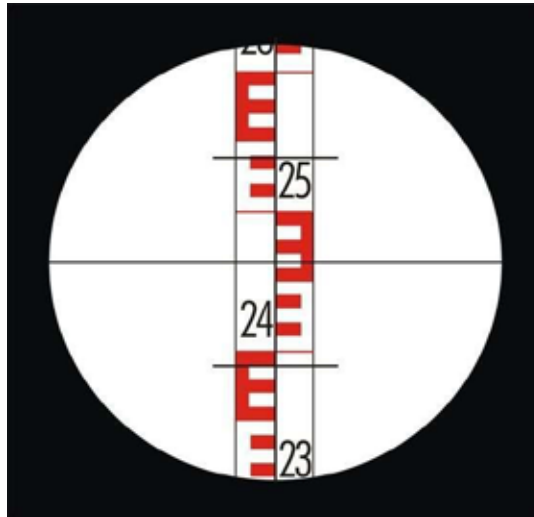
Distance to staff = $0.094 \times 100 = 9.4$ metres

Note that stadia distances have a low level of accuracy, one mm error in staff reading gives a distance error of 0.1 metre



The Staff

The staff is held vertically at the point being checked – accuracy of survey depends on accuracy of holding staff!! The bubble is used to check vertical.



Reading the Staff

1. Open up staff to required length; make sure sections are firmly locked.
2. Make sure staff is held upright – check bubble level on back of staff.
3. The dumpy telescope allows readings to be made over a long distance. Focus the telescope cross hairs first using the eyepiece control.
4. Point dumpy at staff using the gun sight on the telescope.
5. Focus on the staff using the focus on the side and the horizon direction control.
6. Read off horizontal cross hair on the staff
7. Readings are in millimetres
8. Record readings on a log sheet at 2m intervals.
9. Example staff reading showed in this picture is 2464 mm

Remember that every time the dumpy is setup it will be at a different height; if readings need to be on the same base level, reading to a fixed datum must be taken every time dumpy is set up.

Levelling staff.

Two staffs are shown, note slight differences in the marking and numbers. The "E" pattern is designed to make it easy to read a small section of the scale when seen through a telescope. The staff is simply a large ruler, available in lengths of 3, 4 or 5 metres and usually made of aluminium with telescopic sections.

The sections have locking buttons to ensure accurate length is maintained.

Some staffs also have an extended length scale in mm on the back.

For the "E" Staff Measurements are in metres and cm (10mm blocks) which enable heights to be estimated to 1 mm.

It is important to keep level plumb.

- Slowly rock level back & forth towards Dumpy level
- Use vertical line in level to keep plumb

Check that the staff is vertical.

It is essential that readings are taken when the staff is vertical. If the staff is not vertical the reading will be larger than it should be, as you are measuring a slope distance, and will give errors.

Some staffs are fitted with a spirit level and handles to help the staff person keep it vertical. Even with a spirit level it is difficult to hold a staff vertical. This difficulty increases in wind.

To read the staff when vertical the surveyor uses the vertical reticule line to direct the staff person to move the top of the staff left or right of the sight line.

Staff Reading Errors

- Misreading
- Confusing the “E” and reading upper 50mm of graduation (i.e. misread by 50mm)
- Reading meters from graduation above
- Telescoping staff not extended properly
- Dirt, mud concrete accumulating on bottom of staff
- Staff not plumb

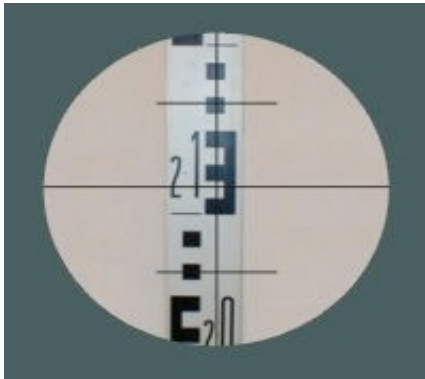


LEANING FORWARD

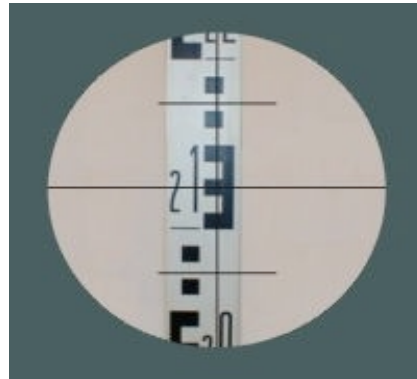
AND



BACKWARD



FORWARD



BACKWARD

The Excel Workbook

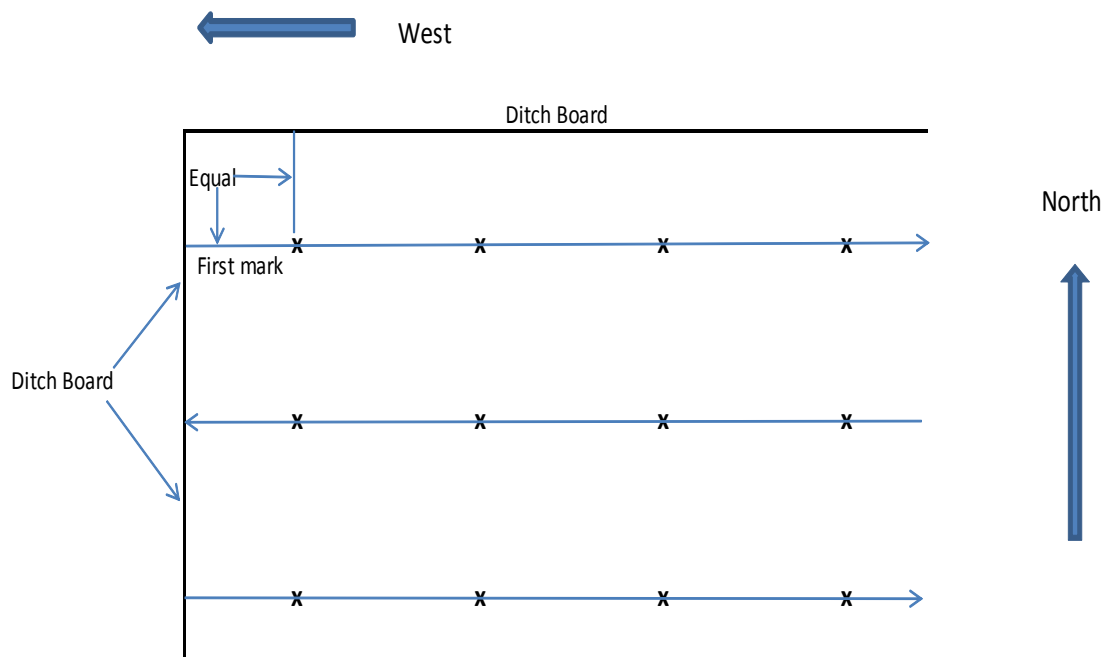
- The bowling green is visualized as an (18x18) Excel spreadsheet with a reading in each cell. Excel spreadsheets are processed left to right starting at the top left corner. The Excel calculations are dependent on spreadsheets being oriented top/North, right/East, left/West and bottom/South
- Readings on the green must be taken in way that mirrors the Excel spreadsheet. Readings start at North/West corner of green moving across green to West; then 2 meters to South returning East to West; then 2 meters South – repeating pattern until completed.

Survey Process

First reading at a point equidistant (length to first mark on cord) from the two sides at North/West corner. Read at every mark on cord, end of row move cord 2 meters using canes then read in reverse direction. Repeat until whole green is surveyed.

Make sure readings correctly recorded on “Survey Log”. Staff moving West to East record readings left to right; when staff moving East to West record readings right to left. Note arrows on “Survey Log”

The survey must be done exactly as outlined; operation of the spreadsheets requires this.



Positioning the Dumpy

1. Choose a position for the dumpy with a good line of site to the datum and green. Usually the centre on edge of green.
2. Set up the dumpy and staff, make sure staff sections locked.
3. First reading after set up and last reading before packing up are to the datum.
The datum must be a permanent fixed point e.g. a peg set in concrete that is never disturbed.
4. First reading on the green is taken at a point equidistant from the two sides at North/West corner. Repeat crisscrossing the green until whole green is surveyed.
5. Make sure that readings are correctly recorded on the "Dumpy Log". When staff moving West to East record readings left to right on "Dumpy Log", when staff moving East to West record readings right to left on "Dumpy Log".

Survey Interrupted

It may be that the survey has to be interrupted, in this case proceed as follows:

- Mark last reading on "Dumpy Log"
- Mark row interrupted on ditch boards

When restarting survey, after setting up dumpy proceed as follows:

- Use same "Dumpy Log" as before
- Enter date above original date, read datum and enter reading above original datum reading.
- Use marks on ditch boards to restart at interrupted row – complete rows.

In Summary

Levelling a bowling green is an exact exercise. The profile of the bowling green shows the highs and lows that define the exercise. Decision on how to proceed is then based on this info.

Use of the Excel Workbook

- Better Information
- Better Options
- Better Planning
- Better Results



Green: Date: Datum: Greens 35x35 to 37x37 meters

NB Orient leveling log at start - top of page North. Then take readings from top left i.e. N/W corner of green - this ensures that all worksheets are identically oriented. All readings are in millimetres there are no decimal points. First and last readings always to datum to check that dumpy has not moved. Readings are taken crisscrossing green e.g. from left to right returning right to left - readings must be recorded in the same way.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	N/E
1																			→
2																			→
3																			→
4																			→
5																			→
6																			→
7																			→
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17																			→
18																			→
S/W																			←



Input Spreadsheet

Open "Cubitt's Green 364" workbook; click on Input to open "Input" spreadsheet, press home key – sets cursor at start, enter "Green Name", "Date", "Datum" and "Dumpy Readings mm" taken across green.

Next click on label "Profile" and enter a value (in range of dumpy readings) into "Level To" field; a profile of the green surveyed will be generated.

Once data entered use "Save As" function to create an Excel workbook of the green surveyed

Green Name:	Jones	Date:	20/08/2016	
		Datum	2139	Level
				1042

Dumpy Readings mm																		North
1/2	1030	1038	1042	1039	1039	1037	1034	1041	1039	1036	1032	1031	1036	1031	1031	1030	1036	1036
2/4	1032	1042	1049	1050	1048	1049	1050	1049	1046	1044	1043	1040	1041	1040	1039	1038	1039	1039
3/6	1033	1041	1045	1049	1052	1051	1049	1049	1042	1044	1044	1049	1042	1040	1041	1041	1040	1040
4/8	1033	1045	1045	1048	1052	1051	1049	1044	1041	1044	1047	1048	1044	1042	1044	1041	1040	1040
5/10	1026	1044	1046	1044	1045	1050	1049	1047	1041	1041	1041	1047	1040	1040	1039	1039	1037	1037
6/12	1031	1045	1049	1048	1046	1052	1055	1049	1043	1041	1045	1042	1041	1038	1038	1039	1038	1038
7/14	1032	1048	1047	1043	1047	1054	1058	1051	1049	1043	1042	1045	1042	1039	1041	1035	1037	1037
8/16	1034	1048	1046	1045	1045	1050	1052	1050	1050	1042	1040	1043	1042	1042	1047	1045	1042	1042
9/18	1035	1043	1047	1052	1049	1049	1049	1049	1048	1043	1043	1042	1047	1042	1047	1048	1041	1041
10/20	1034	1041	1042	1048	1050	1048	1047	1048	1045	1045	1044	1041	1045	1041	1048	1043	1040	1040
11/22	1037	1040	1045	1050	1044	1044	1045	1043	1044	1042	1039	1042	1041	1048	1048	1044	1043	1043
12/24	1031	1040	1044	1050	1050	1044	1048	1045	1048	1043	1041	1040	1041	1044	1045	1040	1041	1041
13/26	1030	1041	1047	1051	1053	1049	1049	1050	1047	1042	1041	1041	1043	1046	1047	1036	1039	1039
14/28	1033	1042	1038	1046	1046	1050	1048	1050	1047	1046	1047	1042	1037	1037	1032	1031	1040	1040
15/30	1034	1042	1036	1038	1044	1049	1049	1048	1048	1048	1044	1041	1038	1033	1029	1036	1040	1040
16/32	1032	1041	1037	1039	1044	1049	1048	1047	1048	1050	1050	1049	1041	1033	1036	1032	1040	1040
17/34	1031	1040	1038	1042	1045	1045	1052	1058	1050	1050	1050	1050	1050	1040	1031	1034	1041	1041
18/36	1031	1040	1038	1042	1045	1045	1052	1056	1050	1050	1050	1050	1050	1040	1031	1034	1041	1041
	1/2	2/4	3/6	4/8	5/10	6/12	7/14	8/16	9/18	10/20	11/22	12/24	13/26	14/28	15/30	16/32	17/34	18/36

N.B. Drag-and-drop or cut-and-paste not allowed when Inputting readings

BSA Level Points Spreadsheet

This spreadsheet calculates BSA Level Points from dumpy survey readings. It has no input fields; readings are automatically extracted from the input spreadsheet to calculate the BSA Level Points.

Green Name	Jones	Date	12/6/2017	Green as Surveyed with BSA Level Points scored															
>4 mm	-4 to +4 mm	<-4 mm	% Points in range -4 to +4 mm of surveyed level																71%
1/2																			
2/4		-6	-8	-10	-10	-10	-10	-11	-10	-9	-10	0	-2	-13	-9	-8	-6		
3/6		-6	-7	-8	-9	-8	-9	-10	-8	-9	-8	-9	-8	-9	-10	-10	-6		
4/8		-6	-4	-6	0	-1	-1	-2	0	-10	-8	0	-1	2	3	4	4		
5/10		-8	-10	-10	3	-1	0	-2	2	-2	0	-2	-2	-5	0	1	0		
6/12		-11	-7	-9	-2	-3	-7	-4	0	1	-3	-2	0	-2	-2	0	4		
7/14		-6	-3	-3	-7	-8	-5	-2	4	7	0	1	2	4	4	0	0		
8/16		-4	-3	-10	-3	-3	-6	0	2	3	1	1	2	7	4	0	-1		
9/18		-6	0	0	1	2	1	2	2	0	-3	2	4	6	3	1	2		
10/20		-7	-2	-8	0	5	5	1	0	-3	-6	0	0	1	3	-1	-8		
11/22		-2	3	-4	1	1	-1	0	-1	0	0	4	4	-2	0	1	0		
12/24		-5	-2	-6	1	-7	1	3	1	1	0	4	1	2	0	4	0		
13/26		-7	-2	-4	-2	-5	-5	0	0	1	0	1	1	1	1	4	6		
14/28		-3	-1	1	1	-4	1	2	0	0	0	0	1	2	3	4	-3		
15/30		-7	-7	-4	1	-4	2	1	6	2	2	4	2	2	2	0	-10		
16/32		-8	-10	-8	0	-1	-5	2	1	0	1	2	-2	-3	1	-2	-9		
17/34		-2	-4	-1	2	1	-3	1	0	1	1	-2	-1	-4	0	1	-2		
18/36																			
1/2 2/4 3/6 4/8 5/10 6/12 7/14 8/16 9/18 10/20 11/22 12/24 13/26 14/28 15/30 16/32 17/34 18/36																			
BSA Level Points out of 30 Max calculated from Dumpy Survey 30 x 71% equal 21 Points																			

North



Profile Spreadsheet

Created by calculations in the Workbook. It shows all the information about a green's levels. By studying the profile, the scale of the leveling exercise can be assessed:

- High, low and level areas are highlighted.
- Estimates cubic meters top dressing required.
- % green leveled if low points are filled to "Level To" value.
- Maximum cut and maximum fill

The spreadsheet has one input field – "Level To" – that is used to try different levels.

PC's printer produces a high quality colour print of the profile.

Any area on green can be reached by using row/column numbers as co-ordinates.

GREEN NAME

DATE

Reading to Datum				2139				Reading to High Point				1682				Reading to Low Point				1703				Level To				1690			
High				Level				Low				Level Set At				1690															
1/2	0	-2	-12	-11	-10	-10	-6	-10	-8	0	-2	-8	-10	-10	-7	-8	-10	-6													
2/4	-7	-6	-8	-10	-10	-10	-10	-11	-10	-9	-10	0	-2	-13	-9	-8	-6	-6													
3/6	-8	-6	-7	-8	-9	-8	-9	-10	-8	-9	-8	-9	-8	-9	-10	-10	-6	-10													
4/8	-7	-6	-4	-6	0	0	0	-2	0	-10	-8	0	0	2	3	4	4	5													
5/10	-10	-8	-10	-10	3	0	0	-2	2	-2	0	-2	-2	-5	0	0	0	0													
6/12	-12	-11	-7	-9	-2	-3	-7	-4	0	0	-3	-2	0	-2	-2	0	4	-2													
7/14	-7	-6	-3	-3	-7	-8	-5	-2	4	7	0	0	2	4	4	0	0	0													
8/16	-8	-4	-3	-10	-3	-3	-6	0	2	3	0	0	2	7	4	0	0	-6													
9/18	-10	-6	0	0	0	2	0	2	2	0	-3	2	4	6	3	0	2	-9													
10/20	-13	-7	-2	-8	0	5	5	0	0	-3	-6	0	0	0	3	0	-8	-10													
11/22	-11	-2	3	-4	0	0	0	0	0	0	0	4	4	-2	0	0	0	-10													
12/24	-9	-5	-2	-6	0	-7	0	3	0	0	0	4	0	2	0	4	0	-8													
13/26	-9	-7	-2	-4	-2	-5	-5	0	0	0	0	0	0	0	0	4	6	0													
14/28	-8	-3	0	0	0	-4	0	2	0	0	0	0	0	2	3	4	-3	-4													
15/30	-8	-7	-7	-4	0	-4	2	0	6	2	2	4	2	2	2	0	-10	-9													
16/32	-8	-8	-10	-8	0	0	-5	2	0	0	0	2	-2	-3	0	-2	-9	-6													
17/34	-2	-2	-4	0	2	0	-3	0	0	0	0	-2	0	-4	0	0	-2	-3													
18/36	0	0	0	0	0	0	-2	0	8	2	5	7	0	3	0	0	0	0													
1/2	2/4	3/6	4/8	5/10	6/12	7/14	8/16	9/18	10/20	11/22	12/24	13/26	14/28	15/30	16/32	17/34	18/36														

North

North



Maximum Cut 8

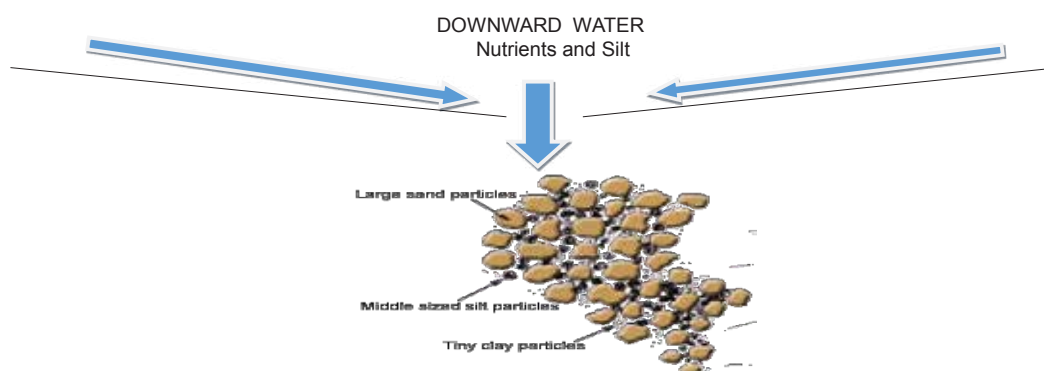
Maximum Fill 13

Estimated Fill m3 4,93

% Green Levelled 82%

What takes place when a surface is not level.

UNLEVEL SURFACE



WATER PULLS FINE SILT PARTICLES ALSO NUTRIENTS WITH IT TO THE LOWEST AREA CAUSING COMPACTION IN LOWER AREAS AND HIGHER AREAS TO HAVE NUTRIENT DEFICIENCIES.

This is seen when green has dry areas across the green.

(Commonly known as Dry or Hotspots)

Levelling Rails



Green areas where the higher areas were prior to Levelling.



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Special mention must go to Ron Cubitt for his contribution to the Surveying and Levelling of Greens chapter, also the scoring points.

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Notes

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