Dusting of Golf Greens in Victoria

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The Victorian Golf Association Turf Research and Advisory Board undertakes trial work of potential benefit to Victorian golf clubs. This report reviews the principles of dusting, summarises the results of trial work by Board member David Nickson, conducted while he was Course Superintendent at Peninsula Golf and Country Club, and examines case studies of various clubs who have used dusting to improve the greens surfaces over recent years.

The Problem: Thatch

Thatch is defined as an intermingled organic layer of dead and living shoots, stems and roots that develops between the zone of green vegetation and the soil surface (Beard, 1973). All turfgrasses accumulate thatch over time, and thatch removal is the major reason for greens renovation practices.

A certain level of thatch has some benefits to the green, improving the turf's resilience to wear and traffic damage. However there are disadvantages from allowing an excessive thatch accumulation due to its sponge-like nature which reduces the agronomic and playing quality of the putting green.

The first major disadvantage of excessive thatch is its lack of mechanical strength. It is a very soft and compressible layer, easily marked by foot traffic and pitchmarks and resulting in a bumpy surface.

The second major disadvantage of excessive thatch is due to its water holding capacity. It is a very water absorbent layer, holding somewhere around 25% of its own weight in water. This high Moisture Retention results in the greens frequently being soft and slow, and can also encourage moss, algae and slipperiness problems. From an agronomic point of view it also encourages the roots to ramify within the thatch layer and not penetrate to a good depth in the soil.

On sand-based greens this high Moisture Retention creates an extra problem, leading to the development of a perched water table in the thatch layer. In this situation the Moisture Retention of the thatch layer can rise to 50% or more (by weight), which reduces or eliminates the movement of oxygen into the profile and causing an anaerobic Black Layer just below the thatch (see photo).

Anaerobic Black Layer just below a severe thatch layer

Why thatch develops

Thatch accumulation is a natural by-product of the greens management system. Modern golf greens rely on aggressive turfgrass growth to provide recovery from wear and maintain a uniform, dense surface. This aggressiveness comes from two directions - the turfgrass variety, and from the agronomic inputs (water, fertilizer and pesticides).

Bentgrass varieties bred specifically for putting greens have an extremely high shoot density - none more so than the recently bred cultivars (eg: A and G series bents and others). An inevitable consequence of this high density is a high thatching tendency. Past attempts to use lower thatching varieties of bent resulted in a proportional reduction in wear tolerance. *Poa annua*, of course, is an extremely dense and aggressive grass in its own right.

Why thatch develops

On top of the density and aggressiveness of the grasses, greens are managed with high inputs of irrigation, fertilizers (especially nitrogen) and pest protection chemicals. They are also required to grow actively for the whole year, when in their natural environment they usually have a period of summer dormancy.

In short, the combination of aggressive turfgrass genetics and continuous high input levels creates conditions where thatch accumulates, probably at an average of 12mm per year. Attempts to reduce thatching by selecting less aggressive varieties or reducing inputs (especially nitrogen) will not be successful on greens experiencing high levels of play, although these strategies could be considered by clubs with low numbers of rounds (less than 20,000 rounds per year, for example).

Conventional Thatch Reduction

Reduction of thatch is achieved through a combination of natural decomposition and mechanical removal. The conventional mechanical removal methods include scarifying (also called vertical mowing, dethatching or grooving), and coring. While coring does not remove much thatch, it does punch holes through the thatch blanket to allow increased oxygen and water penetration through that layer. It also creates channels through any layering effects that may have arisen from variations in topdressing material, periods without renovation etc.

While decomposition and mechanical removal of thatch are certainly important, research at Peninsula G.C. has shown that these conventional processes on their own are not able to prevent some thatch accumulation. More needs to be done.

Dusting: the theory

The turfgrass research team of Madison, Paul and Davis from UCLA, Davis, initiated a technique called Frequent Sand Topdressing in the early 1970's. Their technique employed frequent light applications of sand (around 1 litre per square metre) every three weeks to putting greens, with two aims - first to ameliorate the thatch layer, and secondly as an alternative to full sand reconstruction for older, soil-based greens.

The central principle behind dusting is that a blend of sand and thatch is far better than a pure thatch layer on the surface. The sand:thatch blend has a better mechanical strength (firmness) and a lower moisture holding capacity than a pure thatch layer.

With this in mind, the logistical requirements of an effective dusting program start to emerge:

- To create an even blend of sand and thatch, the sand needs to be applied **as the thatch accumulates** millimetre by millimetre. Hence the need for frequency.
- Applying sand before or after the thatch accumulates will simply result in layering, which is counter-productive.
- Depending on the turfgrass species, the nitrogen rate and other factors, thatch probably accumulates at a rate up to 1mm in depth every two weeks in good growing weather. So you need to apply some sand and drag mat it into that layer at around that frequency.
- To create a 50:50 blend of sand and thatch, you need to apply 1mm of sand for every 1mm of thatch accumulation.
- A 1mm depth of sand is equivalent to 1 litre of sand per square metre of green, or alternatively 0.1 cubic metres of sand per 100 square metres of green.
- So our "standard" dusting program consists of an application of 0.1 cubic metres of sand per 100 square metres of turf, around every two weeks in good growing weather (less frequently in the winter months).
- Such a program will require a total of around 18 - 20 dusting applications per year. Most Superintendents will retain at least one renovation period each year to enable some conventional scarifying and coring work.

By matching the thatch accumulation with a corresponding depth of sand, the resulting layer will be a 50:50 mix of sand and thatch. Remembering that thatch has a moisture holding content of around 25%, and if we assume the sand has a moisture holding content of 5%, the resulting sand:thatch mix will have a moisture content of 15% (the average of the two components).

Note that a less frequent application of sand will result in layers of thatch (moisture holding content 25%) alternating with layers of sand (moisture holding content of 5%). Such layers create unfavourable agronomic conditions in the rootzone and must be avoided.

The Expected Results of Dusting

This simple technique dramatically ameliorates the two main thatch problems we looked at earlier - its lack of mechanical strength, and its high water holding capacity. The greens surface will be firmer and hold less moisture.

Research has also shown that the rate of thatch decomposition will increase, due to increased activity of beneficial soil microbes in the thatch:sand layer. This increased microbial activity has also been shown to reduce disease.

The dusting program will result in a more rapid increase in surface levels each year. This may be a problem, but in older 'soil-based' greens (eg: push-up greens) it can be beneficial, eventually building up a substantial depth of 'new' profile based on the sand:thatch blend, and building the green up out of its underlying soil-based problems. This was one of the intentions of the originators of this technique, Madison, Paul and Davis, who saw this outcome as an alternative to re-construction of old greens.

Where the increase in the greens level does create a problem, Superintendents may need to look at taking the top off the greens every 10 years or so. With modern computer-based surveying and laser-guided sand shaping equipment it is feasible to recreate the exact greens contours in such cases. The added benefit may be the ability to switch to newer bent varieties during this process, as well as removing the accumulation of *Poa annua* in the greens.

Dusting: the Peninsula trial work

Dusting of greens was the subject of a Sydney University Masters thesis by Turf Board member, Mr. David Nickson. In 1994-1996 he conducted a replicated trial at Peninsula Golf and Country Club to investigate the dusting technique and compare it with other thatch management practices.

A newly constructed, sand-based nursery was sown with 'Providence' Creeping Bent in August 1994. After establishment the mowing height was reduced to 4mm, and the green received conventional greens irrigation, fertilizer and mowing maintenance. In October 1994 the green was divided into plots for the nine different thatch management treatments. Each of these nine treatment plots was replicated three times, giving 27 individual plots each 4m x 2m. A 1m buffer strip was maintained between adjacent plots. Because the green was not in play, traffic and wear damage was simulated using a spiked roller.

The nine thatch management treatments were:

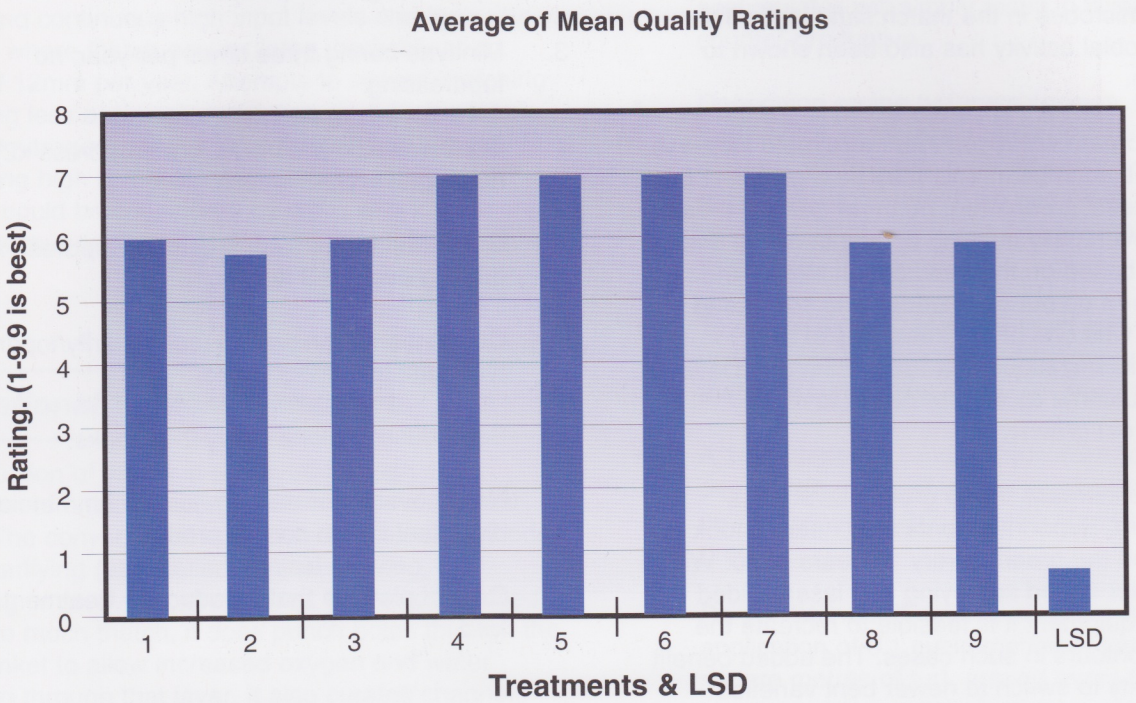
1. Conventional renovation by coring and topdressing twice per year.
2. Conventional renovation by scarifying and topdressing twice per year.
3. Minityne coring three times per year, no topdressing.
4. Conventional renovation (core/topdress x2) plus dusting every 2-3 weeks.
5. Conventional renovation (scarify/topdress x 2) plus dusting every 2-3 weeks.
6. Conventional renovation (core/scarify/topdress x 2) plus dust every 2-3 weeks.
7. Sand dusting alone every 2-3 weeks.
8. No renovation or dusting, just a commercial biological thatch control product.
9. Control plot. No thatch reduction treatment of any kind.

To make it easier when interpreting the results and graphs that follow, just remember that **plots 4, 5, 6 and 7 were dusted every 2 -3 weeks**, and the other plots weren't.

The plots were assessed monthly for their visual quality, disease and quality after wear. They were also sampled and assessed half-yearly for root and thatch depth, shoot density, infiltration rate and other parameters. Those interested in the full details of the trial work can source the Masters thesis from the Faculty of Agriculture, Sydney University, or contact David Nickson directly.

Results

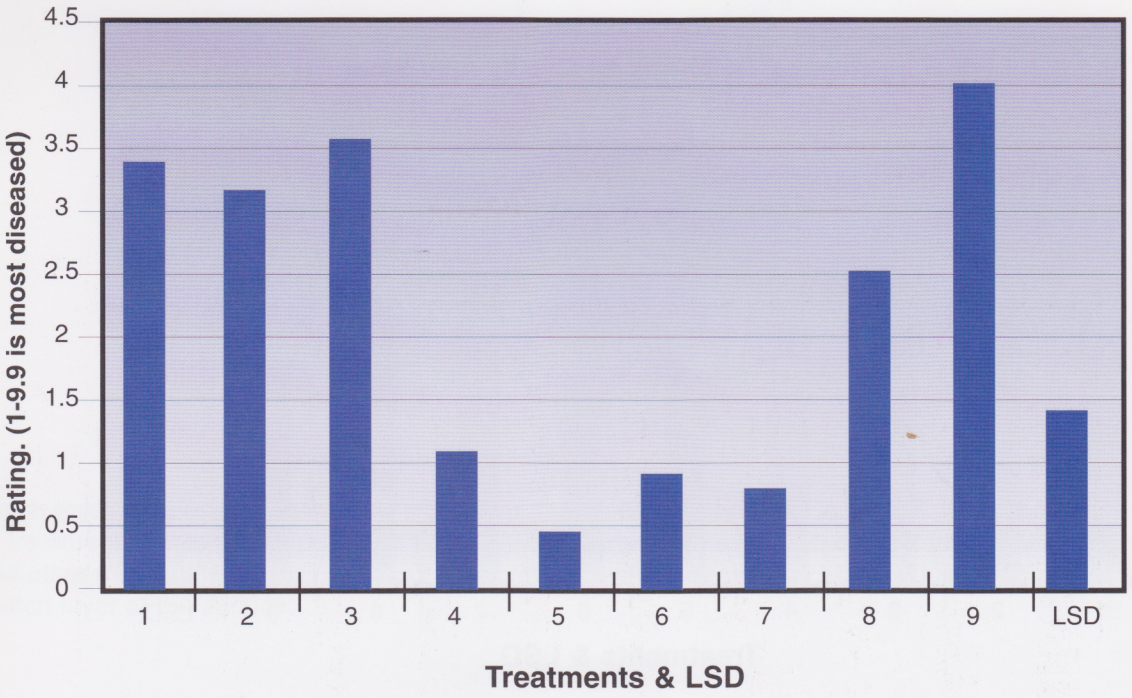
1. Visual Quality: As indicated in Graph 1, the four dusted treatment plots (No. 4 - 7) all had significantly better visual quality when averaged over the life of the trial.



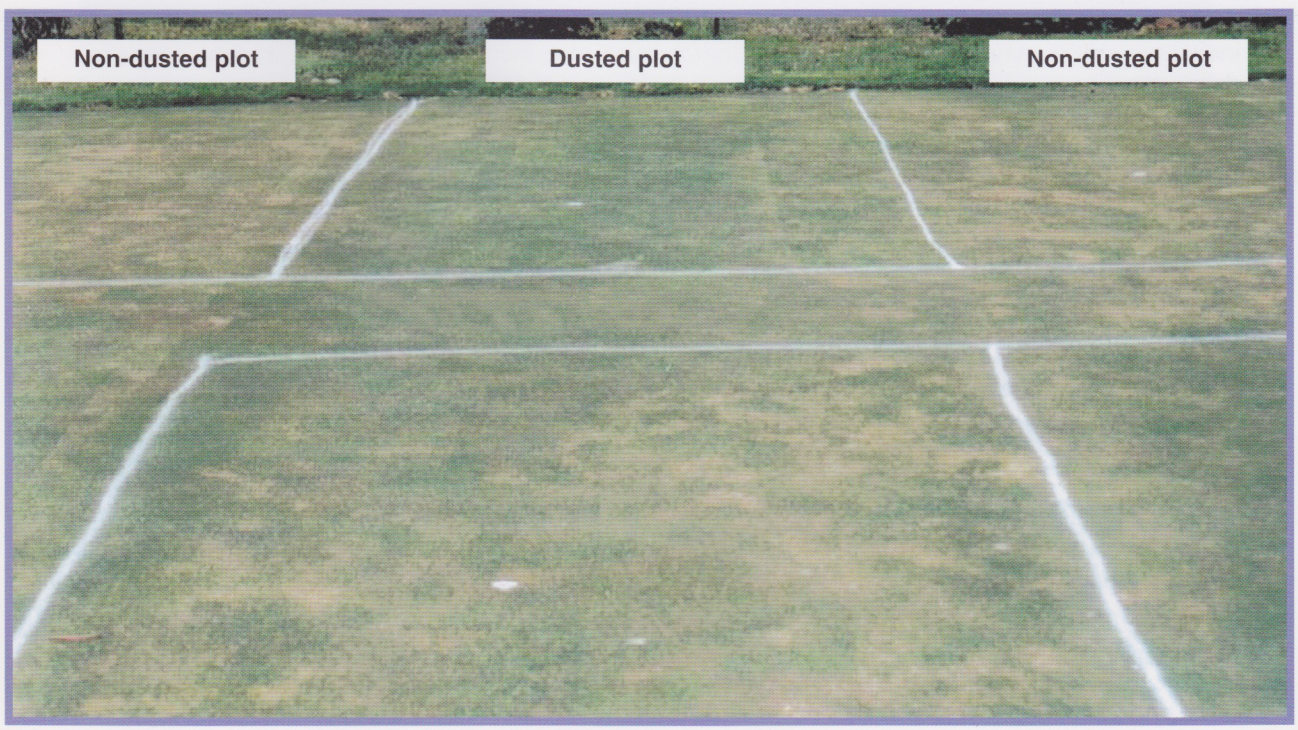
2. Firmness: The dusted plots always felt firmer underfoot and exhibited less footprinting, particularly during wet weather or after irrigation. Unfortunately neither the Penetrometer or the Impact Hammer proved suitable for the measurement of this surface firmness. Every club that starts a dusting program notices the extra firmness of the greens, even within a few months. The firmness can be felt under your shoes, but we weren't able to measure and quantify it in this trial.

3. Disease incidence: During February and March of 1995 fungal disease *(Curvularia and Phoma)* caused severe damage to the non-dusted plots, but all four of the dusted treatments showed dramatically reduced disease severity, as shown in the graphs and photograph. All four dusted plots had noticeably reduced levels of dew formation, and the reduction in disease could be attributed either to that or to an enhancement of biological diversity and activity, or a combination of those two factors.

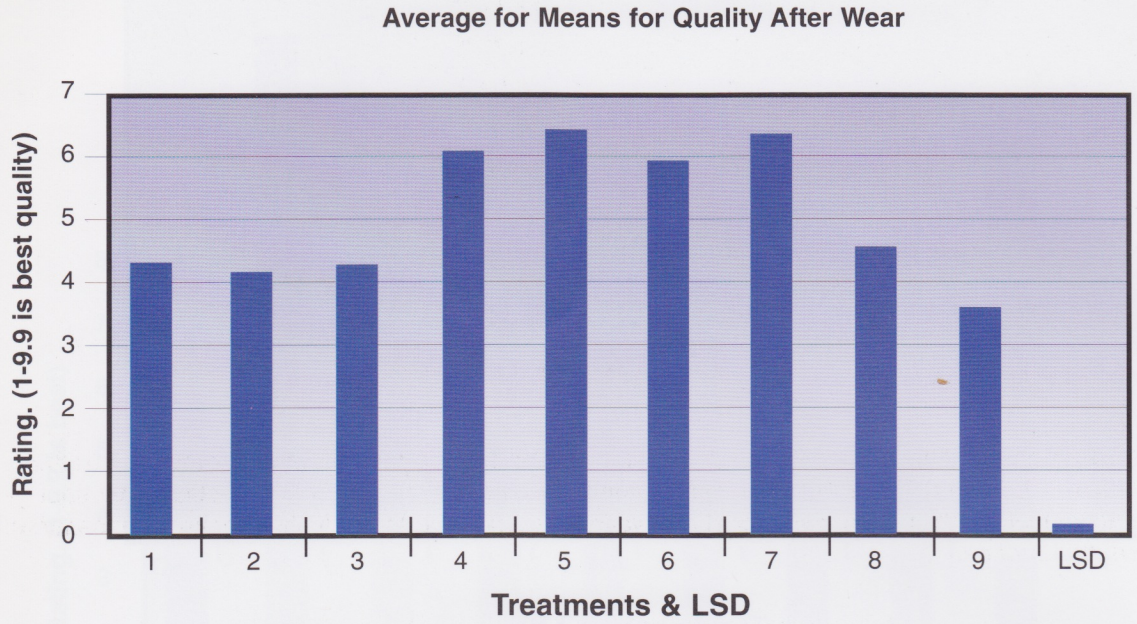
Average of Mean Disease Ratings (3/95-3/96)



Impact of dusting on disease resistance, Peninsula G.C., March 96



4. Resistance to Wear: the four dusted treatments all maintained a significantly higher visual quality after severe wear treatments, in comparison to the non-dusted plots (see Graph).



5. Scalping: Visual assessment showed that all four dusted plots had less mower scalping damage compared to non-dusted plots.

6. Organic Matter concentration: all four dusted plots had a lower organic matter concentration compared to the other plots (Table 1), significantly lower when compared to the unrenovated plots (Nos. 8 and 9). Not only was the organic matter concentration of the surface layer lower, but the dusted plots also had significantly less total organic matter levels (Table 2) by the end of the trial, indicating that dusting not only diluted the thatch but it also increased the rate of thatch decomposition.

Table 1: Organic Matter Concentration (grams of organic matter per cubic centimeter of the thatch layer) at three assessment dates. Treatments followed by the same letter are not significantly different (P = 0.05 level).

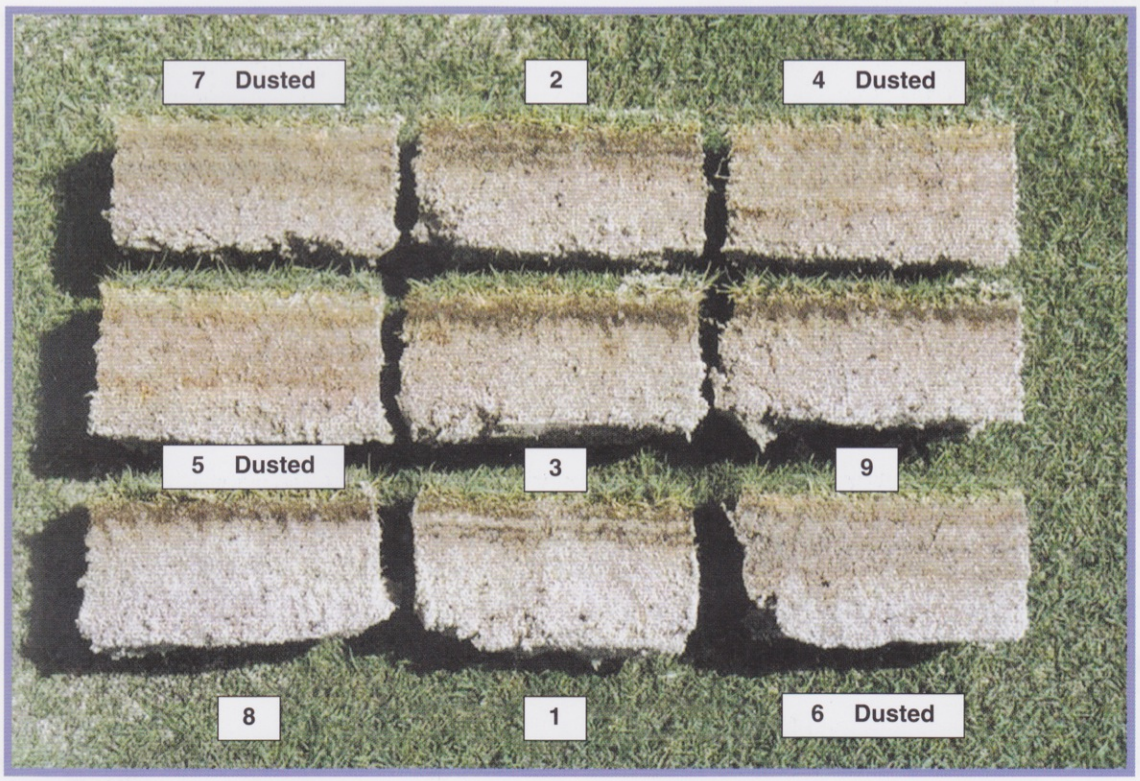
Treatment	Mar-95	Sep-95	Mar-96
1	0.104 ^{a}	0.060 ^{bc}	0.032 ^{cd}
2	0.056 ^{b}	0.054 ^{c}	0.030 ^{d}
3	0.102 ^{a}	0.096 ^{a}	0.052 ^{bc}
4	0.043 ^{b}	0.032 ^{c}	0.017 ^{d}
5	0.036 ^{b}	0.033 ^{c}	0.017 ^{d}
6	0.056 ^{b}	0.042 ^{c}	0.012 ^{d}
7	0.049 ^{b}	0.036 ^{a}	0.016 ^{d}
8	0.125 ^{a}	0.085 ^{ab}	0.073 ^{a}
9	0.134 ^{a}	0.057 ^{bc}	0.063 ^{ab}
	LSD 0.04	LSD 0.03	LSD 0.02

Results

Table 2: Organic Matter (grams) in Thatch

Treatment	March, 96
1	1.25 [b]
2	1.17 [bc]
3	1.70 [a]
4	0.83 [d]
5	0.93 [cd]
6	0.89 [cd]
7	0.94 [cd]
8	1.64 [a]
9	1.62 [a]
	LSD 0.3

The thatch levels and concentration in the different treatments can be seen in the following photograph. In the dusted treatments (plots 4,5,6 and 7) the thatch is well diluted with sand and doesn't form a distinct dark spongy layer. All other treatments, including the conventional renovation treatments without dusting, have a concentrated dark thatch layer at the surface.



Plug samples from treatment plots after 2 years of treatment

Conclusions

The results of the trial confirm the necessity for addressing the need for thatch control on new greens from the earliest opportunity, although a low level of thatch is desirable to reduce wear and traffic damage.

Conventional renovation, namely coring and scarifying twice per year or either of these methods performed alone, were not effective on their own in controlling or managing thatch. These conventional methods are effective only if performed at high frequency which is generally not tolerated due to playing requirements.

A commercially available biological thatch control agent (Treatment 8) is marketed as an aid in the degradation of thatch layers formed on putting greens. Under the conditions of the experiment there was no measurable effect of thatch reduction associated with this product.

All four dusted treatments showed:

1. A significant improvement in visual quality ratings of the putting green
2. Increased firmness, resulting in less footprinting and mower scalping
3. A significant reduction in disease
4. A reduction in damage resulting from wear
5. A reduction in organic matter concentration, and a reduction in the total level of organic matter in the surface layer

An examination of plugs taken from the plots suggested that the combination of thatch accumulation plus the added sand from dusting was producing a resilient surface layer where the fibrous components of the organic build up were acting as reinforcement in the mechanical matrix with the applied sand providing structural strength. This reinforced layer was then better able to withstand the forces imposed by traffic and wear. This observation is born out under practical observations in the field and supported in the literature.

The trial also concluded that management considerations are extremely important if a sand dusting program is decided on for thatch control. The need to continue the program without hesitation is paramount: layering will occur if a stop and go attitude exists, and sufficient labour and the correct equipment is essential for success.

With all requirements met there will still be occasions where the correct frequency of dusting cannot be followed due to scheduled events, weather conditions or equipment breakdown. For these reasons it is recommended that a dusting program be combined with annual or twice annual coring (hollow or solid tyne) in order to break through any slight layering that may form. The trial work also noted that during the summer the dusting sand can be hosed into the surface after application.

Dusting: Case Studies

We traveled to three golf clubs to look at dusting programs in action. These case studies give a range of situations, from older 'push-up' greens to new sand-based greens, from Poa/bent greens to pure bent greens, and from high budget clubs to clubs with a more modest budget. In all cases the dusting program was a great success, with the benefits in greens quality, firmness and smoothness far outweighing the costs and disruption caused.

Eastern G.C.

The greens at Eastern Golf Club could be described as push-up greens, and were traditionally firm in the dry weather but soft and puggy in the wet. They are a blend of *Poa annua* and bentgrass. Golf Course Superintendent Clayton Howell started dusting the greens at Eastern Golf Club in October, 1993.

With a build-up rate of around 10mm per year, the greens now have a sand:thatch depth of around 110mm over the old greens soil (see photos).

Clayton dusts the greens every 2 weeks in the September-May period, and every 4 weeks in the June-August period (a total of around 21 dustings). The process needs two workers, and takes them from around 7am - 10.30am each time, spending only 3 - 4 minutes to treat each green and using around 0.1 cubic metres of sand per 100 square metres of turf (equivalent to 1mm depth of sand). They use a Rocla medium washed sand, and spread it through a Vicon fertilizer spreader. The Vicon is attached to a turf tractor with low compaction tyres. The sand is then brushed into the surface.

The dusting usually takes place on a Monday, and the greens are not mown again till the Wednesday to avoid removing sand in the catchers. The greens are no longer scarified during the year, although they are aerated with the Vertidrain using the larger tines once a year, and the needle tines several times during the year.

Clayton sees the main advantages in the dusting program being firmer, smoother and 'truer' greens with less footprinting. The surface dries more quickly after rain and there is no ball plugging. The turf is denser, has a deeper root system and the profile has better drainage with no anaerobic layers. Clayton rolls the greens to increase green speed and smoothness, and finds the firmer, drier greens surface reduces wet weather 'down time' for rolling and other maintenance practices that had to be suspended in the past due to pugginess.

The main disadvantages are the disruption during the actual dusting operation, and minor problems for the next two days or so especially on dewy mornings when the golf ball picks up sand. Mowers require more frequent backlapping and more frequent replacement of bottom blades.

Cost is not a huge issue. Capital costs were incurred in the purchase of a turf tractor with a suitable low ground speed (around 1.2km/hr) and low compaction tyres suitable for greens work, and in the purchase of the Vicon spreader. The agitator in the spreader is treated with hard-facing to reduce wear on this component. The annual cost for sand is around $5,000 and manpower costs can be estimated from the information given above.

After a couple of years of dusting, Clayton found the greens were firmer but the surrounds were still sloppy, so he has increased the area of dusting to include the greens surrounds and especially the front approach. While dusting hasn't eliminated some fundamental problems on the greens, such as Fusarium and some puddling due to saucer-shaped greens contours, it has improved greens quality substantially.

Eastern Golf Club green. The top 120mm or so is the result of eight years of dusting, and is a blend of sand and thatch. The heavier soil of the push-up greens can be seen deeper in the profile.

The Vicon spreader used at Eastern Golf Club for dusting.

Metropolitan Golf Club

The greens at Metropolitan are all recently reconstructed sand-based greens with pure bentgrass surfaces. Golf Course Superintendent Richard Forsyth has had a dusting program in place for several years, and recently expanded it to include the nursery area which he uses to re-turf greens during any reconstruction work.

Richard dusts the greens every two weeks in the growing months, backing off to every 4 weeks over winter. The process takes two workers around 5 hours using a Tycrop topdressing/dusting unit. They use a Rocla 60:40 mix with the same physical properties as the construction sand. The quantity of dusting is around 0.6 - 1 litre of sand per square metre (which works out to 0.06 - 0.1 cubic metre of sand per 100 square metres, applying a sand depth of 0.6 - 1mm to the surface).

The greens are mown or rolled straight after application (when dry) using an older mower with the height set around 1mm higher than the standard greens height. The usual greens mower (at the usual height of cut) is used again after three or four days.

The greens receive a conventional renovation program, with coring twice a year. Richard sees the main benefit of the dusting program as the dilution of the thatch layer and the creation of a firmer, smoother putting surface with finer leaf texture.

The main disadvantages of dusting is the damage to the mowers which requires more frequent backlapping and bedknife replacement. Player inconvenience is also an issue for the 3 or 4 days following dusting, especially on dewy mornings when the sand sticks to the ball. This doesn't disrupt or even unduly slow down a putt, but it is a nuisance.

Another potential disadvantage could occur if the thatch layer on a turfed green becomes buried, leaving a sandwiched thatch layer under the surface. Richard tries to avoid this by heavily coring turfed greens to encourage the dusting sand to key into the underlying greens profile.

The main costs involved include the purchase of the topdressing unit (around $18,000), labour, and sand ($5 - 6000pa).

Metropolitan Golf Club green. The top 30mm or so is the sand:thatch mix, over the relatively recent sand construction.

The Tycrop spreader used by Metropolitan Golf Club

Bairnsdale Golf Club

The greens at Bairnsdale are a bent/Poa mix with a variety of construction histories, some being sand constructions and others consisting of the local sandy loam. Course Superintendent Noel Williamson has been dusting the greens for around three years, using a Turfco spreader pulled behind an old roughcutter. The greens are dusted every 2 weeks in the growing months and every 4 weeks or so in the colder months.

The dusting material is a Rocla 80:20 mix, and the quantity used each dusting is around 0.5 litres of sand per square metre (equivalent to 0.05 cubic metres of sand per 100 square metres, or 0.5mm depth of sand per dusting). The process takes around 1.5 hours for two operators, which includes matting the sand in.

The greens still receive a conventional renovation in the spring with the greens being closed for coring and scarifying. The greens are also aerated with the Vertidrain using the small tines two or three times as required during the year.

Noel sees the main advantage of the dusting program being a firmer green with improved surface quality, a reduction in disease and pesticide use, and better drainage (in conjunction with the use of the Vertidrain). The members are very happy with the greens and there are no complaints regarding the minor disruption caused by the program.

Noel is hard pressed to find any disadvantages of the program apart from the slightly higher wear and tear on the mower blades. He uses an older greens mower for the first couple of days after dusting.

The main costs of the program include the purchase of the Turfco topdressing unit (around $17,000), the labour, and the sand (around 60 cubic metres per year, costing around $2,000).

Bairnsdale Golf Club green. The top 70mm or so is the sand:thatch mix over the heavier 'native' soil

The Turfco topdressing unit used at Bairnsdale Golf Club

Conclusions

1. Dusting has the potential to improve the surface quality and agronomic conditions of all greens types, from new sand based greens sown with the latest bent variety, through to old push-up Poa greens.

2. The improvements will be most noticeable in improved firmness, smoothness and quality of the putting surface. Other benefits include reduced disease incidence, reduced pesticide use and better agronomic qualities in the rootzone.

3. Embarking on a dusting program will require an initial investment in equipment, materials and labour, but these costs are not prohibitive.

4. Careful homework is needed in the planning stage to ensure the correct sand is used, at a rate and frequency needed to produce the results.

5. For clubs with greens that are not currently being dusted, the Board feels that the single most important technique that will improve greens quality is dusting.

Recommendations

For a dusting program to be effective, clubs must commit to the full program ensuring adequate frequency of dusting. The basics of this program are as follows:

1. Select a permeable, free-draining sand with a low moisture retention. The material must have a particle size analysis coarser than the material currently in the green. If you're not using a sand in general use, use a consultant or soil testing laboratory to test for suitability.

2. Purchase suitable application equipment that allows efficient spreading, loading and travelling.

3. The first dusting event should be done on greens that have been heavily scarified and cored, and the initial application should be heavy (at least $0.2m^3$ per $100m^2$). The program can only start in a period of active turf growth (ie: spring or autumn).

4. Apply dusting at a rate of 0.6 - 1.0 litres per square metre (0.06 - 0.1 m^3 per $100m^2$) on a frequent basis - every 2 weeks in the spring, summer and autumn period, dropping back to monthly dusting over the winter.

5. Drag mat the material into the surface to provide some blending with the thatch. Hosing the sand in during the summer can also be tried.

6. Hold off mowing or use a second greens mower for a couple of days to avoid some of the dulling effect the sand will have on mower blades.

The recommendations in this report are based on a set of trials and conditions as laid down within this report and should not be taken as a decisive or conclusive recommendation.

Each club's circumstances are different and it is hoped that this research assists clubs and superintendents to make relevant decisions that are best suited to their club's particular needs.

Further Reading:

Beard, J.B. (1973): Turfgrass Science and Culture. Prentice-Hall, N.J., USA, 658pp.

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Madison, J.H., Paul, J.L. and Davis, W.B. (1974): A new management programme for greens. USGA Greens Section Record. May, Vol 12(3). Pp 16-18.

Nickson, D.C. (1997): Thatch Control on a newly constructed bentgrass putting green built to a modified USGA specification. Master Thesis, held at the Faculty of Agriculture Crop Science Dept. library, University of Sydney.

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Other Publications

Footnote:

An interesting photo (courtesy of M. Beddison, Horsham Golf Club) showing a section of greens profile. The top 100mm of soil has been uniformly dusted, while the deeper part of the profile shows the results from past renovation practices of heavy topdressing with sand once a year. The bands of sand and thatch can be counted like the rings in a tree trunk.