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Creeping Bent Grass and Poa annua analysis for Golf Course Putting Greens for:

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August 2020

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About the Report: This report has been commissioned by Colin Campbell Chemicals Pty Ltd to obtain an independent insight into the management and maintenance of golf greens consisting of Creeping Bent Grass (Agrostis Spp.) and Winter Grass (Poa Spp.). The report will give an insight into the advantages and disadvantages of both species from a practitioner's perspective rather than a scientific one. The report will look at the required inputs to manage golf greens of both species and the difference, if any, in those inputs.

The Author recognises that Colin Campbell Chemicals has/or is in the process of registering the chemical Poacure (Methiozolin) for the control of Poa annua in Bent Grass putting greens in Australia and that information in this report may in the future be offered to potential clients if they consider the information is appropriate to the clients specific needs. Given the author has had significant experience with the product Poacure (Methiozolin) prior to Colin Campbell Chemicals having a commercial involvement in the product, any reference to the products in this report is based on the authors knowledge and experience with the product.

The report does not offer recommendations but offers information for the use in assessing the appropriate grass for golf course putting greens, their specific requirements, and, environments.

The Author: The author of this report is Gary Dempsey. Gary has some forty six years' experience in Golf Course management and maintenance industry and has managed golf greens at all levels of input, including a small nine hole golf course with two staff to a high end world renown golf course, New South Wales Golf Club at La Perouse in Sydney, where he was Golf Course Superintendent for 29 years. In 2018 Gary retired from Golf Course Superintendency and has continued to work within the industry as director of his company Golf Course Management Pty Ltd offering the benefits of his years of knowledge and experience to the industry. Gary's qualifications include: Certificate in Greenkeeping – Diploma in Horticulture (Turf) – Certificate III in Landscape Construction – AQF IV in Chemical Application – Certificate IV in Training and Assessment.

The Grasses: Both grass species have their own advantages and disadvantages, and both can provide excellent playing surfaces in suitable environments. In the wrong situation both can be extremely difficult to maintain in consistently good condition. Both plants are susceptible to many turf diseases and these are more prominent in sub-Mediterranean climates such as the warm humid environments of the Australian east coast. They are both also susceptible to insect damage, particularly Argentine Stem Weevil in warmer regions. Both require intensive manual and mechanical inputs to achieve good quality putting surfaces with the quality achieved being directly related to the funding which golf clubs are willing to afford.

Creeping Bent Grass: For many years prior to the 1960's golf greens from Sydney to Melbourne consisted mainly of Colonial bent grass or Brown Top Bent grass. These were tenuis grasses which in the right environment produced excellent putting surfaces. Unfortunately, these grasses were very susceptible to disease and insect attack and had extremely poor heat tolerance making their management very difficult maintain in a sub-Mediterranean climate. They were also very prone to Poa annua invasion as they struggled during hot humid conditions. In the 1960's the incidence of creeping bent grass golf greens begun to multiply rapidly as turf managers discovered the advantages of the creeping bent grasses. Penncross was the initial varietal and was very successful in adapting to certain Australian climates, particularly the east coast. One of the main reasons for success of Penncross was that in those years' greens were generally maintained at cutting heights of between 4 and 7mm. Penncross can flourish under these regimes and gave the creeping plant a distinct advantage of the invading Poa annua. It also contributed to the resurgence of golf's popularity in the 1970's providing improved putting greens more regularly and club memberships began to swell. As demands for faster and firmer greens from golfers emerged so did the problems associated with those demands, lower heights of cut allowed for more Poa annua invasion, more disease, more water use due to shortened roots systems and ironically more disease from the use of more water. One other significant problem of the era was steel spiked golf shoes which caused a serious problem to closely mown bent grass golf greens. Somehow the spike marks on greens were linked to poor greenkeeping ability and golfer's poor standard of ability could be purely directed at the greenkeeper of the day.

About this time plant breeders (particularly in the USA) begun to breed creeping bent grasses with particular genetic traits that make them more adaptive to the changing demands of golfers and their ego's. Seed companies begun to produce new bent grasses by the masses each with a special characteristic, better disease tolerance, better drought tolerance, finer and denser turf quality, deeper root development and any other trait that might be a requirement of a prospective customer. Unfortunately, not always do the best of these hybrids make it to market. The author has witnessed firsthand when visiting a seed research facility in the 1990's and seeing some outstanding potential hybrid grasses only to see them eliminated for ever because of their inability to produce commercial quantities of seed. The author has also visited Bent Grass seed production areas such Madras in the Mesa country in Oregon in the USA. Bent grasses are grown in climate akin to desert conditions, 40-degree Celsius daytime temperatures with extremely low humidity. Which is a testament to the versatility of the grass and how they are now bred to adapt to certain climatic circumstances and the pressures applied to them via their management.

There is no doubt that Creeping Bent Grass is the benchmark for golf course putting greens worldwide, no matter what the cultivar good management and maintenance practices can produce favourable playing surfaces for the golfing community. The most important note to remember when you commit to Creeping Bent grass greens is that you must also commit to a lifetime Poa annua control program. This report will discuss the maintenance and management of Creeping Bent Grass verses Poa annua later in the report.

Poa annua: Commonly known as Winter grass, Meadow grass, Annual Bluegrass and many other common names throughout the world and is without exception the most adaptable plant species on the planet. It is the only plant found on every continent on Earth, it can reproduce all year round in most all climates and can produce viable seed even in golf greens cut as low as 2.5mm. It comes in many different biotypes both annual and perennial. Some of the perennial varieties produce very little seed head and are very dense and prostate in growth habit and have are deep green in colour making for a very attractive and versatile turfgrass. It has been both praised and cursed by golf course superintendents worldwide for generations.

For golf greens, Poa annua, in the right climate and managed well can produce some of the best quality putting greens in the world. Areas like northern California and the tri state area (New York, New Jersey, Philadelphia) in the US produce some of the best Poa annua greens and more often than not the US Open is played on Poa annua greens. The author has experienced this firsthand at three US Opens, Congressional Golf Club 1997, Pebble Beach Golf Club 2000 and Shinnecock Hills 2004 and have also witnessed perfect Poa annua greens at the top two golf courses in the world, Pine Valley Golf Club NJ and Cypress Point Golf Club Ca. The author has managed Poa annua golf greens at many levels and hosted six major international tournaments on Poa annua greens.

So, with such an outstanding resume why then would the golfing and turf world not embrace this unique plant? Well, let's look at the pros and cons.

Pros:

- Tenuis upright growth habit.
- Excellent putting surface
- Very dense growth habit.
- Good cold tolerance.
- Self-sowing

Cons

- Poor heat tolerance
- High disease susceptibility
- Shallow root system
- High water dependency
- Profuse seed head production
- Poor colour (annual varieties)
- High thatch production
- High maintenance costs
- Poor acceptance by golfers (patrons)

When you way up the pros and cons it does look to be a close race, however, it is not until you add the location into the mix do you see the real picture. Poa annua grown in the cool climates can flourish, northern hemisphere summers can be brutal but are short and Poa tends to survive reasonably well. Alternatively, as Poa annua migrates to the sub

Mediterranean climate or transitional zone is where it starts to develop significant issues. It is in this climatic regime where the conundrum of whether to let Poa annua invade Creeping Bent Grass greens and manage it, or, put in place a control program to endeavour to keep it out or to minimum in Creeping Bent Grass Greens. In this climatic zone (such as Australia's east coast) none of these choices are easy. Wild weather swings such as drought, heat or flooding rains can set upon us at any time, to ask a plant like Poa annua to perform consistently through these variables may just be too silly a question to ask! However, there are golf course superintendents who accept this and manage very good Poa annua greens in this environment. Others are in dread of the approaching summer each year. The glaring fact however is that no matter what climate regime that Poa annua exists in it still has its inherent flaws that see it fall well short of Creeping Bent Grass as a consistent quality putting surface, especially in the sub-Mediterranean climates where golf is played year round. It is this fact in particular that drives golf clubs in Australia to strive for Creeping Bent Grass Greens over Poa annua Greens. Changes in the appearance, smoothness, firmness, and green speed throughout the seasons are most often attributed to the degree of Poa annua in a putting green at any given time of the year. While those with creeping Bent Grass Greens enjoy the benefits of more consistent greens year-round, they are also under intense scrutiny from members and golfers as to levels to which they can resist the invasion of Poa annua in their greens. Those who succeed to restrict Poa annua invasion in their green are often lauded for their efforts and expertise. The introduction and judicious use of a product like Poacure (Methiozolin) could have a significant impact to the turf management industry as it will offer many in the industry choices in turf management and maintenance they have not previously had.

Economies in the Maintenance of the Grasses on Greens:

It is often talked about that Poa annua greens are much more expensive to maintain than Creeping Bent Grass. The author has had extensive experience in managing both species of grasses in the golf green environment and at varying levels from general public play to international tournament condition and has over the years had to assess the economics of both the maintenance and management of both grass species. The author has also converted Poa annua greens to Creeping Bent Grass greens on an existing golf course which has allowed him to have an intimate knowledge of the economics of the management of both species. It is my intention to now look at some of the management practices associated with both grasses and what if any differences in economics may apply. It must be remembered that the greens on a golf course usually only consist of approximately one hectare of the total area of the golf course, however it is the intensity of the management of that one hectare that drives the costs of managing it upwards. The following determinations are deduced form the authors own experience in managing both grass species at the same site.

Mowing: Poa annua greens were attempted to be mown 7 days a week year-round using walk behind mowers, at times on inclement weather and during renovation these regimes would differ. Regular mowing was necessary to combat the different growth rates of the many different biotypes of Poa annua in the greens and to remove seed head from

the plant to help keep the surfaces smooth. Alternatively, Creeping Bent Grass greens were mown every day during the summer and mowing was decreased by around 2 days per week during a normal winter season. This is generally due to the slower growth rate and lower golfer numbers during the winter months. During the summer months, especially if tournaments are on the schedule, Creeping Bent Grass could be double cut on some days.

These practices suggest that Creeping Bent Grass is slightly cheaper to maintain in regard to mowing on an annual basis by approximately 6% as compared to Poa annua greens.

Rolling: Both Poa annua and Creeping Bent Grass greens were on average rolled twice per week, that number would increase during tournament preparation however the frequency would usually increase or decrease similarly for both species greens therefore there would be no difference in their maintenance value.

Renovation: Depending on the type of renovation practices exercised costs between the two different grass can be significantly different.

Poa annua greens were always renovated heavily twice per year. During the renovation and the recovery time (approximately 6 weeks) there was a substantial reduction in player numbers and therefore a significant reduction in income to the club. This is unavoidable with Poa annua greens in a hostile environment and economic losses were calculated into budgets during this period.

Creeping Bent Grass greens renovation can be of a similar process as the Poa annua greens process and a number of superintendents follow this regime. However, a system of renovation developed by the author offered a totally different scenario as to twice yearly heavy and disruptive renovations. Greens were cored between 8 and 10 times annually with 7mm “Ninja Tines” this could be achieved in a very quick time frame (around 4 hours) with very minimal impact on play and full recovery achieved in a couple of days. Therefore, there were no economic losses in regard to income during renovation periods.

The economic benefits of either of these scenarios would apply differently to individual clubs as budgetary restrictions could have an impact on being able to have success with the economics of each scenario.

Other seasonal supplementary coring, slicing, solid tinning, and verti-draining are generally performed on as needed basis and would be of similar frequencies between the species.

Top Dressing: When top dressing Poa annua greens it generally two heavy top dressings at renovation time and limited light dustings during the growing season.

With Creeping Bent Grass however, the practice of dusting greens with kiln dried sand is practiced on a more regular basis, sometimes weekly through the growing season offering minimal disruption

While sand quantities applied will be similar annualised labour costs for these practices would see the Creeping Bent Grass greens labour cost around 20% higher than the Poa annua greens.

Fertilization: The author has always maintained a low nutrient input program for maintaining both species of grass. This is to maintain minimal growth and optimise green performance. For Poa annua greens nutrient input was at higher regimes than for Creeping Bent Grass. This was to compensate the plant for its stresses from climatic and disease pressures and seed head suppression, especially during the summer months. The programs for both species are based on an as needed basis and takes into account local daily climatic conditions, traffic stress, irrigation requirements and plant analysis. With this in mind it is difficult to offer an accurate guide as to savings due to the influencing factors, however, given the lower nutrient requirement of the Creeping Bent Grass and considerably lower application frequency annually one can determine that a saving of up to 40% in greens fertilizer budget when comparing Creeping Bent Grass to Poa annua.

Irrigation: There is a significant difference both physically and financially when comparing water management for Poa annua greens and Creeping Bent Grass greens. Water volume intensity and frequency are significantly higher when managing Poa annua greens. Poa annua has a shallower root system which requires strict monitoring during summer to ensure suitable moisture levels are maintained. Poa annua will wilt rapidly under drought and traffic stress and the results can be devastating. The author experience with Poa annua greens is that under certain climatic conditions they can see a requirement of up to 25% more irrigation water than Creeping Bent Grass greens. The costs of applying that water are compounded by the costs of the water (if the water is required to be purchased), electricity, irrigation system wear and tear etc. When considering hand watering practices, plant requirements, labour and equipment costs must added to the irrigation scenario which can see the management of the Poa annua greens be up to 30% more expensive than Creeping Bent grass greens when hand watering programs.

Some research has shown that the use of certain highly effective wetting agents and surfactants can offer up to 40% water savings when irrigating greens. These savings can be seen in both species however they are better witnessed in Creeping Bent Grass greens due to their lower water frequency and requirement.

Disease and Pest Management: The difference in the use of products, rates, application intervals and even methods can be extremely varied between the two species and even between the cultivars within the species. It is however been the authors experience that the most effective control of pests and diseases is the adoption of a preventative disease and pest control program. The adoption of a preventative disease and pest program for Poa annua greens will be significantly different to one designed for Creeping Bent Grass. Poa annua will generally be more susceptible to Pythium and Anthracnose while Creeping Bent Grass can be more susceptible to Dollar Spot and Brown Patch under different management regimes and climatic conditions. In climates such as Sydney and surrounds Poa annua clearly require more stringent disease control programs than in more favourable climates.

The same will apply for the introduction of a pest control program. For example, while the most destructive insect, Argentine Stem Weevil affects both species it can cause more significant damage Poa annua as compared to Creeping Bent Grass and thus the Poa annua greens would require a more intensive preventative program.

It is the authors experience that when comparing preventative disease and pest programs for Poa Annua and Creeping Bent Grass economic savings of up to 50% can be achieved when maintaining Creeping Bent grass greens as compared to Poa annua greens. These savings are mainly attributed to the frequency of applications and the labour attributed to those applications rather than the costs of any specific products to treat individual pathogens.

Herbicide and Growth Regulation: The difference between herbicide programs for the two species is vast. Poa annua greens have no post or pre-emergent herbicide programs required. Poa annua will self-sow and will in the right climatic conditions, out compete invading species. This is the single area where Poa annua greens can economically outperform Creeping Bent grass greens. Of course, this is only so if one is committed to maintain exclusively Poa annua greens.

Herbicide programs for Creeping Bent Grass greens are expensive and exhaustive on resources. Almost 100% of herbicide programs on Creeping Bent Grass greens are targeted at Poa annua control and exclusion. The programs are more often a combination of chemical and physical programs and are continuous regardless of season or climate. Chemical programs consist of pre and post emergent herbicides, growth regulators. Physical programs such as plant stressing and physical removal (plugging) are incorporated with the chemical programs to form a wholistic program. Without the existence of any truly highly successful selective herbicides in controlling Poa annua in Creeping Bent grass greens the cost of chemical control programs have become very expensive and somewhat ineffective and often begs the question as to whether the disruption and the economic stresses are worth it. Of course, superintendents will persist with their programs as the goal of pure or almost pure Creeping Bent Grass seems to be always just out or reach.

The authors experience in this is firsthand. After converting greens from Poa annua to Creeping Bent Grass the first couple of years are easy to navigate. Limited herbicide programs are required, and costs are very low. In the ensuing years as Poa annua invasion increases the costs of trying to control it grow exponentially. Within several years of trying to control Poa annua the costs of the control program can reach a level where is exceeds the cost of fertilizer, fungicide and insecticide programs combined. Also needed to be factored into this is that there can often be a decline in green condition during full blown Poa annua control programs.

It is difficult to generalise on the economic costs of a Poa annua control program as each superintendent will tailor their programs to suit their specific circumstances. It must also be remembered that any Poa annua control in greens will require Poa annua control programs to be extended to tees, green surrounds, fairways and even roughs to try and restrict infection sources. The costs of chemical programs are substantial within itself, however, the cost of labour when exercising a plugging program can be extensive. Incorporating all of the aspects Poa annua control into a single program would be restrictive for many clubs who would not have the financial resources to adopt a wholistic program.

Plant growth regulators are a factor in the management and maintenance of both species and are used to enhance playability of greens, reduce environment stresses, reduce clippings, and supress Poa annua seed head. When used in conjunction with greens management programs plant growth regulators can have significant positive impacts to the playability and health of both species in golf green situations. Economically there is minimal difference in the cost between species when adopting a growth regulator program as part of greens management.

Other Areas of influence affected by Poa annua Invasion

The majority of this report is focused on the relationship of Creeping Bent Grass and Poa annua on golf course putting greens the influence of Poa annua is far more reaching in regard to turf playing surfaces including turf application and turf type.

There is a multitude of sports in Australia other than golf both professional and amateur that rely on quality turfgrass surfaces for their participation and enjoyment, some examples are, Cricket, Horse Racing, NRL, AFL, ARU, Tennis, Soccer, Hockey, and many more. Sports like horse racing and field contact sports rely on stable surfaces, particularly in regard to safety. Infestations of Poa annua with their shallow root system can have a severe effect of the quality of the surface the sport is played on. Surfaces can become unstable and slippery and in certain weather conditions can be considered dangerous, particularly where you have colonised areas of Poa annua amongst a predominant species of grass. The change in texture and “grip” can cause extremely hazardous situations for those playing sport on surfaces exhibiting these characteristics and can have financial implications should a surface become dangerous and unusable. They are often uneven and as Poa annua dies out these surfaces also become very unsightly. The potential use of Poacure (Methiozolin) on sports field surfaces could have a profound effect on the quality and safety of playing arenas and offer sports field managers a sound alternative to current management of Poa annua.

On golf courses, it is my experience that the source of Poa annua infection to putting greens is the without doubt the area surrounding area of that putting green. In most cases that area may be a different grass type and under a significantly different management regime, it be a tee, green surround, fairway or rough. It may also be a different grass type Couch (Cynodon spp), Kikuyu (Pennisetum spp), Fescue (Festuca spp,) Ryegrass (Lolium spp), Zoysia (Zoysia spp), Paspalum (paspalum spp) or other turf type grass.

With this in mind, future Poa annua control programs in golf greens that adopt Poacure (Methiozolin) must consider the inclusion of surrounding areas into any Poa annua control program on golf greens. These types of programs would need to be tailored to suit individual situations and if strategically planned and executed would vital to the success of a Poa annua control program in golf greens.

It would be prudent to include other chemical types and modes of action in these areas that would complement a product such as Poacure (Methiozolin) and also aid in the reduction of costs in an overall Poa annua control program.

Observations from this Report:

Golf Greens management and maintenance is intense in its practice and in its scrutiny, it is also expensive. Mostly, Poa annua greens and Creeping Bent grass greens are very similar to maintain when looking at the economics. Those economics can change dramatically once golfers' level of expectation and willingness to afford it is added to the equation.

Some points identified.

- Creeping Bent Grass greens are the preferred putting by most golfers.
- Poa annua greens can offer excellent putting surfaces but at generally less consistent in condition as compared to Creeping Bent Grass greens.
- Creeping Bent Grass greens offer about a 6% saving as compared to Poa annua greens when looking at greens mowing.
- Depending on the adopted nutrient program a saving of up to 40% when comparing Creeping Bent Grass green to Poa annua green.
- When comparing irrigation requirements Creeping Bent Grass greens can offer up to 25% saving in water usage over Poa annua greens and up to a 30% in the cost of seasonal hand watering programs.
- Disease management programs can be up to 50% less in Creeping Bent Grass greens than in Poa annua greens.
- Poa annua control programs is Creeping Bent Grass greens is the most intensive and expensive program in golf green maintenance.
- Considerable savings can be envisaged if a highly successful selective herbicide becomes available for introduction into a Poa annua control program in creeping Bent Grass greens.
- Other sporting surfaces are adversely affected by Poa annua infestations.

One can deduce for this that Creeping Bent Grass greens can offer distinct advantages over Poa annua greens, in regard to surface quality, consistency and some economic benefits. It is however the area of Poa annua control that sees the maintenance of Creeping Bent Grass management and maintenance costs soar. It is the authors opinion that should Colin Campbell Chemicals succeed in the registration of the product Poacure (Methiozolin) for use in the control of Poa annua in Creeping Bent Grass greens the goal of achieving affordable quality Creeping Bent Grass greens will be more attainable for golf clubs in the wider golfing community. It is also very likely to have very favourable effect on quality and safety of other sports fields and the sports played on them.