Couch Dormancy Trials: Winter 2012

Summary

Two trials were conducted to evaluate a range of treatments and products for reducing couchgrass winter dormancy, or at least improving its colour retention during this time. One trial was applied in autumn, to delay the onset of winter dormancy. The second trial was applied in early spring, to enhance spring green-up. In both cases, Gibberellic Acid provided the most effective treatment, at a rate of 75 – 80 g ai/ha. There seems no reason not to try to keep couchgrass green over winter if clubs wish to spend the money, and these two trials suggest that GA products offer the greatest potential for doing that.

Introduction: Why does couch go dormant?

There are two quite separate reasons why couchgrass goes dormant over winter. The first reason is to avoid Winter Kill. This is where a sudden drop in temperature to somewhere around minus 5 - 7^{o} C causes the cell sap to freeze and expand, which splits open and kills the tissue in any foliage that is still active and green. Usually the whole plant will be killed and the area will need re-planting. Winter Kill is a major problem in many areas of the US, where a northerly wind in the autumn or at spring green-up can bring extremely cold temperatures down from Canada to catch and kill any couchgrass with green foliage. If the couchgrass is already dormant, it won't be killed. So the couchgrasses that are rated in the US as having good 'cold tolerance' are long dormancy varieties. And in states like Texas, Virginia and Oklahoma they will want long dormancy varieties so they don't get hit with Winter Kill problems, even if it is only one year in ten. In Kentucky, apparently, 40% of all couchgrass in the state was wiped out by Winter Kill in 1996-97. Fortunately we don't have Winter Kill conditions in Victoria, so we don't have to worry about this first reason for couch dormancy. And we should ignore the US data (e.g. NTEP ratings) on couchgrass cold tolerance, it's not relevant to us.

The second reason couchgrass goes into dormancy is simply to avoid trying to operate when conditions aren't suitable. The two key conditions that couch responds to are light and temperature. In winter, the poor light intensity and short daylength means that couch is losing carbohydrate (CHO) each day, rather than gaining it. Couch needs a lot of sunlight each day to make CHOs by photosynthesis, but it also uses them each day to stay active. If the amount of CHO produced each day from photosynthesis doesn't keep up with the amount of CHO used each day, it makes more sense for the plant to go dormant until sunlight conditions improve. In dormancy, the plant only uses around 1% of the CHO to stay alive compared to if it was actively growing.

The second important growth condition is temperature, which works in a different way. Each cell is enclosed by a cell membrane, which is made from lipids (fats). Lipid activity is affected by temperature, and by the degree of saturation of the lipid. Saturation refers to the number of cross-linking bonds in the lipid. At high temperatures the lipids are active, which is good for cell activity, but if the temperature gets too high the lipid could become too fluid, and the cell contents could start to leak. The plant is able to adjust the lipid by saturating it more, which stiffens it up and stops it becoming too fluid. At low temperatures the lipids start to seize up and become inactive, which makes the cell processes slow and inefficient. The plant can decrease the lipid saturation, which frees it up more so it keeps working actively even at a lower temperature. These lipid processes are genetically controlled, so couchgrass varieties differ in their ability to un-saturate their lipids in response to cold temperatures. Short-dormancy varieties can de-saturate their lipids and continue growing in cool conditions better than long-dormancy varieties. But the lipid processes are also affected by plant hormones.

There is a lot that isn't known about how plant hormones work in turf and how they can be manipulated. But it seems the main hormones involved in dormancy are two 'positive' growth hormones, Cytokinin and Gibberellic Acid (GA), and two 'negative' hormones, Ethylene and Abscisic Acid. Cold temperatures, and stresses such as wear, drought or low nitrogen, cause an increase in the negative hormones, which counter-act the positive hormones. One effect of this is that the cell membrane lipids de-saturate and become inactive, and push the plant towards dormancy. We should be able to reduce couch dormancy if we try to accentuate the positives and eliminate the negatives (i.e. increase cytokinin or GA).

Finally, we should be able to work on dormancy at both ends of the winter, by prolonging activity and green colour in the autumn, and encouraging faster green-up in the spring.

Summary so far: We don't have to worry about Winter Kill in Victoria, and there doesn't seem to be any reason why we shouldn't minimise couch dormancy if we want to. Couch goes dormant because of light and temperature limitations. The length of couchgrass dormancy is largely genetic, which determines its cell membrane lipid response to low temperature. Plant hormones also affect these lipid responses, with two positive hormones that keep the membranes active, and two negative hormones that inhibit the positive hormones.

C_3 grasses, by the way, are not subject to the same winter problems. Their sap contains a sort of 'anti-freeze', so they don't experience Winter Kill until temperatures drop to – 20^{o}C (although Poa and perennial ryegrass are much more sensitive). And the C_3 mechanism of photosynthesis requires much less light to make carbohydrates compared to C_4 plants, so low light intensity and shorter daylength isn't such a problem. And, finally, their cell membrane lipids have a low level of saturation, so they are much more active at low temperatures. Their big problems come in summer, of course.

Keeping couch out of dormancy

There are number of strategies that can be used to reduce couch dormancy, such as:

1. Variety selection: Santa Ana, Legend, Wintergreen, Grand Prix and Winter Gem have a proven track-record for short dormancy in our climate. It is always important that new varieties are evaluated for their winter dormancy, like the trial on seeded couches that Michael Robinson from SportsTurf Consultants did recently for the ANTEP program.

2. Avoid stress: traffic, soil moisture stress, nitrogen deficiency, sudden low mowing or herbicide application (even simple broadleaf herbicides), can all cause stress to couchgrass and cause it to enter dormancy early or retard spring green-up. Many of these stresses cause an increase in the negative hormones and a reduction in the positive hormones.

3. Plant hormone manipulation: as mentioned, plants produce their own hormones. This can be manipulated to some extent. For example, when couch runners have a lot of room to move and a lot of ground to cover their GA levels naturally rise, and the effect carries over as shorter dormancy in the following winter. That's why couch dormancy is reduced on fairways that are new, or were scarified the previous summer. And stimulating growth with nitrogen also increases natural GA and cytokinin production. But nowadays we can also buy

plant hormones off the shelf, either in organic form (e.g. kelp products, which contain cytokinins and auxins), or synthetic form. The ability to buy and apply plant hormones means we aren't bound by the natural processes in the plant. In theory, products that increase cytokinin or GA should retard the onset of dormancy in autumn, and speed up spring greenup. Also in theory, products that inhibit Abscissic Acid or Ethylene could reduce couch dormancy. In practice, the only affordable and easily obtainable product to work with at the moment is GA. Synthetic forms are available in liquid or powder form.

4. Paint: Another approach to couch dormancy is to mask it with pigments. Three products seem to be on the market here: Par, Green Lawnger, and Vision Pro. Quite a bit of research is being done in the US on this topic; have a look at the article by Brian Whitlark (http://gsr.lib.msu.edu/article/whitlark-new-9-21-12.pdf) or an article in Golf Course Management, Nov 2007 called "Painting dormant Bermudagrass putting greens". The pigment products artificially colour the dormant grass to make it look green, but the darker colour also slightly increase leaf temperature.

5. Carbon products: there are a couple of black carbon products that have attracted a lot of attention. They are difficult to apply, but the darkening effect reduces dormancy, probably by increasing leaf temperature.

Trial work

The Victorian Golf Course Superintendents Association decided to do some trials on couch and dormancy. Most Superintendents are aware of points 1 and 2, so the trials were focussed on the various products that were on the market to reduce dormancy. Two trials were conducted, one at Kew GC in the autumn and one at Riversdale GC in the spring. In each case the products were simply sprayed out as single treatments on a chequerboard pattern, with some treatments applied in a north-south direction and other products in an east-west direction. This allowed various combinations of products to be tested, and some treatments were applied in both directions so their effect at single and double rates could be assessed. Applying treatments as single treatments like this doesn't allow the use of statistics, but the aim was simply to see which products seemed to work, and for how long. Some people might term it a 'squirt trial', which is exactly what it was. The treatments were applied as a single 1.7m wide strip using a pedestrian boom spray delivering 1,000 L/ha water volume.

Trial 1: Kew Golf Club

The first lot of treatments were applied on a still-green Santa Ana fairway at Kew GC on May 21st 2012, and aimed to test how products might delay the onset of dormancy. The plot area rated 8 out of 9 for colour at the time the treatments were applied.

The visual colour ratings for main treatments are shown in Table 1. The main beneficial effect was from Gibberellic Acid (Pro-Gibb), which kept the couch reasonably green until the end of July. The effect only seemed to wear off about a week before the VGCSA meeting at Kew on 6th August, but even then a very slight difference in colour was still visible. The GA colour was a light green, not the darker green colour seen with iron or carbon or nitrogen effects. Double rates of GA had no apparent benefit, but also it didn't cause the couch to get leggy and upright, which can be a problem with excessive GA. The single GA rate was 75 grams of active ingredient per hectare. The Pro-Gibb product is 40% strength, so the rate calculation is 75 g ai/ha x 100/40 = 187 grams of product per ha. This rate works out to a cost of around $200/ha, but there are various GA products around, with various strengths, and some of these might be slightly cheaper.

Photo 1: Kew GC, 29th June 2012, lighter green GA plots north-south and east-west

The application of Carbon Trader or the powdered carbon product caused an immediate darkening of the foliage. This caused an immediate jump in foliage temperatures, as measured by an IR thermometer. The darker carbon-treated foliage temperature was in the range 21 – 22^{o}C, compared to 19 – 20^{o}c on the control plots. This 2^o temperature difference probably increases the activity of the cell membrane lipids, which keeps the cells more active. By two weeks after application (4th June) the carbon-treated strips were still slightly greener than the other treatments, but by late June there was no difference between the carbon treatments and the untreated control plots. Green Lawnger provided no real benefit in this trial. The couch in the untreated control plot was quite green at the time of application, so the green pigment on top of that didn't stand out. By two weeks later (4th June), when the couch had started to lose a little colour, the Green Lawnger effect was not evident. The fertilizer products also provided little benefit. The liquid nitrogen-iron product was applied at double the label rate, hoping to increase the effectiveness of this treatment, but unfortunately it caused a burn, so no conclusions should be drawn from its colour ratings. It was expected that the fertilizer products might interact with the carbon or GA to get an extra benefit, but this wasn't evident.

Table 1: Visual colour ratings, Kew GC trial

	Colour rating (0 - 9)			
Treatment	**4-Jun**	**29-Jun**	**16-Jul**	**6-Aug**
Control (no products applied)	6	5	4.5	4.5
NPK liquid blend (15:1:12) at 1 L/100 m^2	5.5	5.5	4.5	4.5
Calcium nitrate (12%N) at 1.25kg/100m^2	6.0	5	4.5	4.5
Nitro-iron liquid blend at 0.4 L/100m^2	6	5	4.5	4.5
Magnesium chelate: 30g/100 m^2	6.5	5	4.5	4.5
Iron sulphate at 0.7kg /100 m^2	7	5	4.5	4.5
Carbon Trader 0.55 L/100m^2	7	5	4.5	4.5
Carbon Trader at 1.1 L/100m^2	7.5	5	4.5	4.5
Powdered charcoal: 0.55kg/100 m^2	7	5	4.5	4.5
Green Lawnger: 0.4 L/100m^2	6.5	5	4.5	4.5
GA 75gai/ha = 1.875 g ProGibb/100m^2	6.5	**6.5**	**6.5**	5
GA 150gai/ha or 3.75 g ProGibb/100m^2	6	**6.5**	**6.5**	5
Fructose 2.5% conc. (0.25kg/100m^2 in 5L water)	6	5	4.5	4.5

Trial 2: Riversdale Golf Club

The second lot of treatments were applied to a dormant Santa Ana practice area at Riversdale GC on 3rd September 2012, and aimed to test how products might enhance spring green-up. The area was rated 3 out of 9 for colour at the time of application. Colour had improved a little by 13th September even on the control plots, and by the second assessment on 22nd September the plots were well on their way out of dormancy. So the 13th September assessment ratings are probably the most relevant, which was 10 days after treatment.

Once again the GA products had the most beneficial effect. This time two different GA products were used, the 40% strength granule Pro-Gibb, and GALA, which is a 10% strength liquid product. Both were applied at a rate of 80 gai/ha, although there was also a double-strength Pro-Gibb treatment. On 13th September the GA-treated plots were markedly greener. The double rate of GA had no additional greening effect, but caused the grass was noticeably upright, which was undesirable. The combination of Green Lawnger and GA was slightly ahead of GA on its own.

Carbon Trader and the powdered carbon product caused an immediate darkening of the turf, and an average 2°C increase in foliage temperature, the same as in the Kew trial. Double rates of Carbon Trader caused an even darker colour, and on some measurements a 3°C increase in foliage temperature. By 13th September the darkening effect had nearly disappeared but the couch was noticeably greener than the control plots. Green Lawnger, and the other pigment product Par, provided an instant increase in colour rating, but didn’t increase foliage temperature in the same way carbon did. Of the fertilizer products, those containing iron performed marginally better than those without.

Treatment	Colour rating (0 - 9)	
	13-Sep	**22-Sep**
Control (no products applied)	4	7
NPK liquid blend (15:1:12) at 1 L/100 m^2	4.5	8
Calcium nitrate (12%N) at 1.25kg/100m^2	4.5	8
Nitro-iron liquid blend at 0.4 L/100m^2	5	8
Iron sulphate at 0.7kg /100 m^2	5.5	8
Carbon Trader 0.55 L/100m^2	5.5	7
Carbon Trader at 1.1 L/100m^2	6	8
Powdered charcoal: 0.55kg/100 m^2	5.5	7
Green Lawnger: 0.4 L/100m^2	5.5	8
Par 15 ml/100m^2	5.5	8
Hi 5: 100ml/100m^2	4	7
Largo: 100ml/100m^2	4.5	7.5
GA 80gai/ha = 2g ProGibb/100m^2	**6.5**	8
GA 160gai/ha or 4 g ProGibb/100m^2	**6.5**	8
GA 80 gai/ha = 8ml GALA/100m^2	**6.5**	8
Green Lawnger + GA combination	**7**	8.5

Conclusions

There appears no reason not to reduce couchgrass dormancy if a club wishes to spend the required money. There is no doubt that Gibberellic Acid is the most effective of the products tested in delaying the onset of dormancy in autumn, and hastening green-up in the spring. There didn’t appear to be any benefit combining GA with other products. The GA rate of 75 – 80 g ai/ha looks to be suitable, at an estimated cost around $200/ha. The cost of GA was prohibitive in past years, but has come down a lot, and it is probable that it will come down even further in the future. The next question will be to assess a GA program to see if couchgrass can be successfully kept green all winter. A possible program would be an autumn treatment (probably in May, before the couch loses colour), a second treatment in late June or into July, and a final treatment in August. Another question with GA is its effect on Spring Dead Spot, and how it might interact with the growth regulator effect of propiconazole.

Further reading:

Anon: Painting dormant Bermudagrass putting greens. Golf Course Management, Nov 2007.

Gilbert, J.J. and Kopec, D.M. (2001): Spring greenup of dormant non-overseeded Bermudagrass. http://cals.arizona.edu/pubs/crops/az1359

Whitlark, B. and Umeda, K. (2012): A New Hue: a guide to using colorants to enhance the colour and growth of fine turfgrass in the southwester US. USGA Greens Section Vol 50 (20), Sept 2012. http://gsr.lib.msu.edu/article/whitlark-new-9-21-12.pdf