

# CHANGING THE NATURE OF YOUR GREENS

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## THE GREATER GOOD

This article is about favouring the development of the finer grasses. Your putting surfaces will play better and be easier to manage if you allow the bents and fescues to dominate.

My objective is to help you understand that the nature of the environment controls the composition of the sward. With this understanding you can take better control and bring improved quality. If you can see how nature works you may become a better part of it. You need to be able to adapt. I want you to start formulating your greenkeeping strategy in terms of managing environmental pressures. I mean to get you thinking about your greens differently.

This article is adapted from the work of Grime, Hodgson and Hunt in their study: "Comparative Plant Ecology – A functional approach to common British species" (1988). This work states that the vegetation that develops in a place at a particular time is governed by environmental pressures. These pressures may be categorised as stress, disturbance and competition, and they vary in their relative intensities. These pressure factors are described as the three main threats to existence. I make my own interpretations of this work.

## THE THREATS TO EXISTENCE

### Stress

Stress is the environmental constraints to growth and regeneration. It may take a number of different forms, for instance shortages of light, water, mineral nutrients or sub-optimal temperatures. Stress factors may be inherent to an impoverished environment (low fertility, soil acidity) or may be induced (shading or deliberate droughting). Here we are concerned with one or more stress factors that are operating to constrain all species within the environment. Stress factors do not necessarily act in unison, different stresses exert different selection pressures (salt may kill a drought tolerator for example). Greenkeepers have their hands on the reins of certain stress factors, such as fertiliser inputs, irrigation or even acidification.

### Disturbance

Disturbance involves the partial or total destruction of the plant biomass, i.e. the physical damage or removal of living tissue. This may be caused by the activities of pests, pathogens, wind damage, frosting, etc. The primary factors of disturbance within the golf green situation are mowing, scarification, verticutting, wear damage, disease outbreaks, pitch marks and pests. They can vary greatly in their intensity and many are, to some degree, under the control of the greenkeeper. Disturbance places a

high selection pressure upon the vegetation inhabiting an unsettled environment. Rapid recovery or regeneration is required for a plant to exploit regular disturbance.

### Competition

Competition is the tendency of plants to try to monopolise the resources of an environment at the expense of their neighbours. Competition describes the battle for the same light, nutrient, water or volume of space. It refers to the ability of the plant to capture resources and by doing so, suppress the fitness of a neighbour by modifying the environment. This can occur above and below ground. Competition becomes characteristic of environments that contain an abundance of resources and experience a low intensity of disturbance.

### Evolution

So, each environment exerts confining pressures on its inhabitants. These may be external factors such as stress and disturbance or internal such as the competitive ability of the plant itself. Plant growth strategies have evolved over time to exploit specific environmental conditions and forward the continuation of the species. Nature evolves in the direction determined by the environmental pressures.

### Plant Growth Strategies

The primary growth strategies adopted by plants may be categorised by relating the intensity of stress and intensity of disturbance within the environment. See table below:-

Table 1. The basis for the evolution of three strategies in plants. Grime (1977).

Intensity of disturbance	Intensity of stress	
	Low	High
Low	COMPETITORS	STRESS-TOLERATORS
High	RUDERALS	(NO VIABLE STRATEGY)

From the table above, depending on the intensities of the environmental pressures, we see that there are three main growth strategies for plants in their established phase – Competitors, Stress-tolerators and Ruderals.

(Note that there is no possible growth strategy for a highly stressed and highly disturbed environment – such an environment is untenable because the external pressures are too extreme to allow a plant time to survive.)

## PRIMARY STRATEGIES

### *Stress Tolerators*

Stress-tolerators (S-strategists) have evolved to exploit high stress and low disturbance environments. They have the ability to retain resources in a continually hostile environment (deep roots or hardy vegetation). S-strategists are slow growing with the conservation of resources all important. The vegetation is hardened, tough and often difficult to break down. These plants are adapted to cling on in the face of adversity.

### *Ruderals*

Ruderals (R-strategists) inhabit low stress, high disturbance environments. Quick reproduction is all-important. Ruderals are weeds and characterised by fast growth and rapid seed production. There is no point in these plants investing in deep roots because the environment is so unsettled. Reproduction and preservation of the species are imperative for such volunteers.

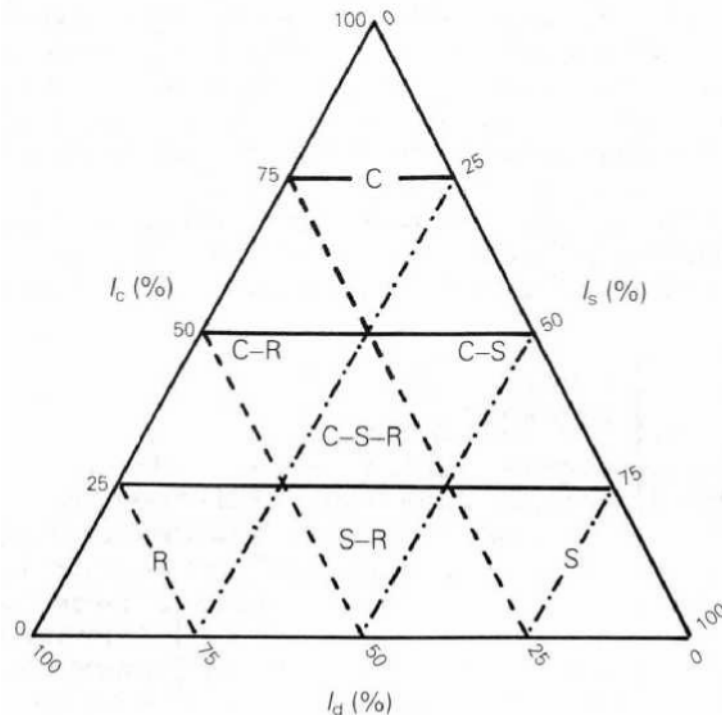
### *Competitors*

Competitors (C-strategists) develop within settled environments of low stress and low disturbance. Allowed to flourish, competitors endeavour to monopolise resource capture (a thick canopy or even a layer of thatch will limit the availability of resources to other species). They create an environment suitable for their own development at the expense of their neighbours. Competitors delay seedhead production in favour of producing vegetation and this weakens their ability to withstand disturbed environments. These plants dominate if conditions are settled enough.

## SECONDARY STRATEGIES

Most environments are not so extreme to simply favour the development of C, S and R strategists. The following diagram describes the secondary strategies that plants may develop to exploit the various intermediate environments. Intermediate environments are characterised by lesser intensities of stress, disturbance and competition.

FIGURE 1. A Model describing the various equilibria between competition, stress and disturbance in vegetation and the location of primary and secondary strategies. C, competitor; S, stress-tolerator; R, ruderal; C-R, competitive-ruderal; S-R, stress-tolerant ruderal; C-S, stress-tolerant competitor; C-S-R, 'C-S-R strategist'.  $I_c$ , relative importance of competition;  $I_s$ , relative importance of stress;  $I_d$ , relative importance of disturbance. (From *Comparative Plant Ecology: A Functional Approach to Common British Species*, Grime, Hodgson & Hunt, 1988.)



Competitive ruderals (C-R) are adapted to cope with a moderate or infrequent level of disturbance (which limits the competition) and low levels of stress. This environment checks competitors but does not eliminate them.

Stress-tolerant ruderals (S-R) occur in lightly disturbed, unproductive habitats. Here, the reproductive opportunities are restricted for relatively short periods.

Stress-tolerant competitors (C-S) occur in undisturbed environments experiencing only moderate levels of stress to allow the development of some competitive advantage.

C-S-R strategists evolve where competition is restricted by only moderate intensities of stress and disturbance. C-S-R strategists are varied in their relative attributes depending on the nature of the stress and the frequency and intensity of disturbance.

## CONCLUSION TO GROWTH STRATEGIES

So, the environment is governed by the three types of pressure – stress, disturbance and competition. Plants species have evolved to survive in specific environmental conditions. The vegetation present in any situation reflects the nature of the environmental pressures.

The grass species present within a golf green will reflect the environment that is being created under preparation and play. The climate and underlying soil type influence the nature of the turf, but within the UK these are generally not overriding factors. More importantly, the turf is constantly being worked at by the greenkeeper as well as being battered and trampled by the players.

The greenkeeper therefore has a huge influence on the turfgrass environment. This influence comes in the form of all greenkeeping treatments from mowing downwards (and includes the protection from pests, diseases and undue wear). As we will see, each treatment exerts its own particular pressure on the environment and when added together they become a prime determinant for species selection. The question is, are these pressures being focused to favour the development of the most desirable grasses?

## THE FINE TURF SURFACE

The putting green is by far the most important surface on the golf course. It is the place where the game is won and lost and it must be perfect! The putting surface must be firm, fast, smooth and true as well as being receptive to a well-hit approach shot. The modern golf green has become an ever more intensively managed environment to achieve these standards throughout the year.

It is obvious to say that sward species composition has a great bearing on playing quality and wear tolerance. Bents, fescues and annual meadow grass are all fine turf species but they produce radically different playing surfaces. A pure fescue (*Festuca*) stand produces resilient and fast putting surfaces that bounce an approach shot forward but wear tolerance declines in the winter. Bentgrass dominance (*Agrostis*) produces fast and true putting surfaces that are receptive to approach shots and fairly wear tolerant throughout the year. Annual meadow-grass (*Poa annua*) produces fine surfaces that are vulnerable to thatch build up, disease attack and drought damage.

The ideal sward composition for golf greens in the UK would undoubtedly comprise an even blend of bents and fescues with minimal amounts of annual meadow-grass. This gives high quality with reduced vulnerabilities.

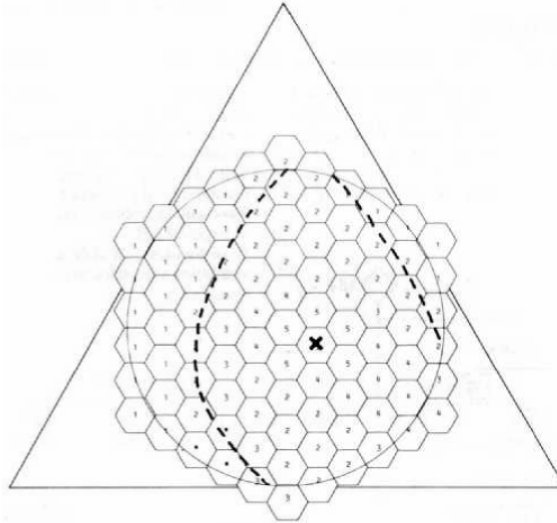
As we will see in the next section, each turfgrass species is adapted to survive in markedly different environments. The trick for the greenkeeper is to create the conditions that favour the development of the desired grasses.

## GROWTH STRATEGIES OF THE FINE TURFGRASS SPECIES

This section illustrates the type of environment each of the various fine turfgrass species have evolved to survive and flourish within.

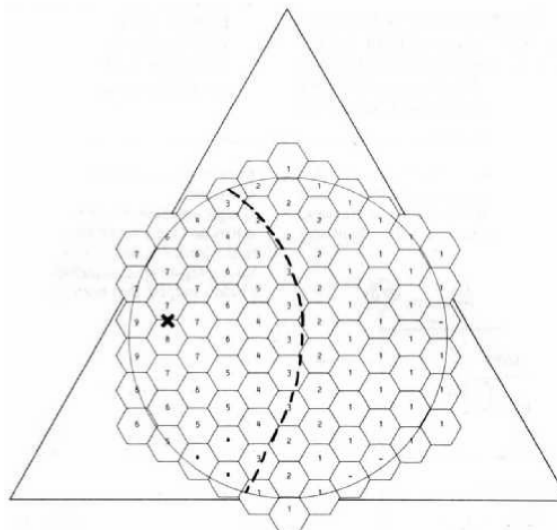
### AGROSTIS

Browntop bent – *Agrostis tenuis*



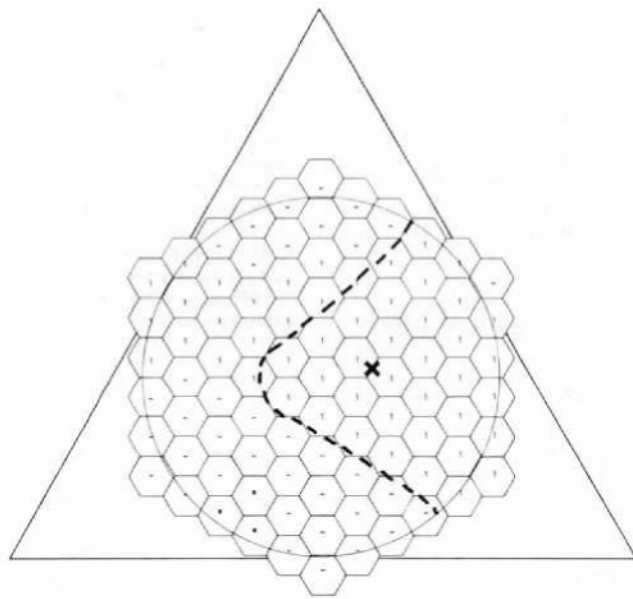
C-S-R strategist adapted to compete in an environment characterised by moderate levels of stress and disturbance. Tends toward stress and withstands an element of acidity, low fertility and drought (but not too much salinity).

Creeping bent – *Agrostis stolonifera*



C-R strategist adapted to survive moderate or infrequent levels of disturbance as long as productivity is high. Needs active growth to be able to recover from disturbance. Creepers build thatch naturally and they suffer if damaged when dormant.

Velvet bent – *Agrostis canina*

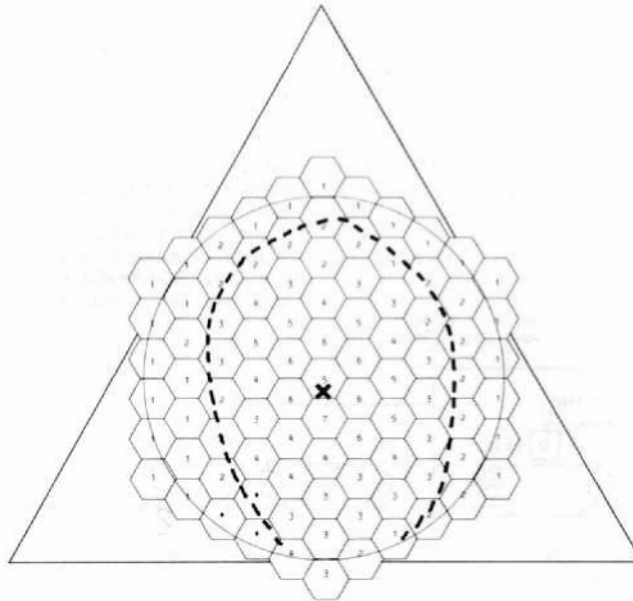


Like the browntops, the velvet bents are C-S-R strategists but they are not quite as active. They tend away from competition and do not welcome high levels of disturbance. Velvets will not respond particularly well to fertiliser applications to help them recover from intensive mowing or verticutting. They do not appear to mind moderate levels of certain kinds of stress. The velvet bents are probably useful in a balanced sward but don't expect them to persist under aggressive treatment.

So, the different bentgrass species are adapted to survive in quite different environments. They therefore require different maintenance strategies to enable them to survive and flourish.

## FESTUCA

Red fescue – *Festuca rubra* ssp. *Rubra*

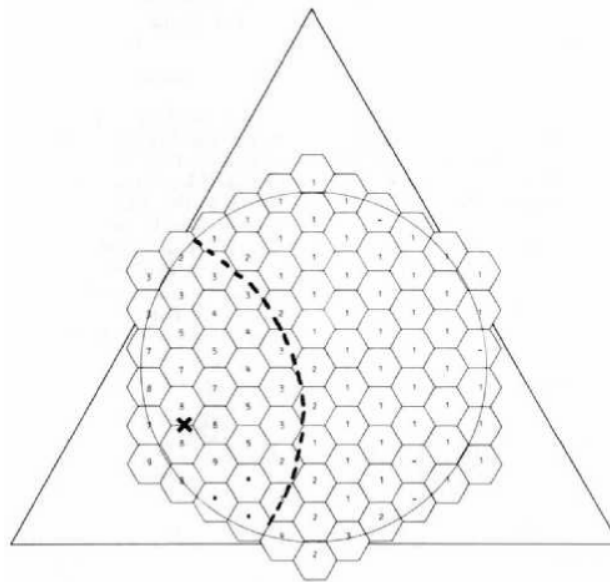


C-S-R strategist adapted to survive a relatively unpressurised environment. They will not flourish where disturbance, competition or even certain kinds of stress are too strong. If the environment exerts too much pressure then the fescues will decline. Be careful with height of cut especially if you need wear tolerance. If pressure is to be used to exclude other grasses it must be well timed and relatively short lived. Encouraging fescues needs an extremely light touch with the greenkeeper ostensibly leaving the pressure to come from the wider environment and then taking care to ease it before too much home ground is lost.

Being hardy, fescues are slow to recover from damage. Significant damage can leave gaps for invasion by other species (think of moss invasion). Deep (or wide bladed) scarification/verticutting should be avoided due to slow recovery. Winter play needs to be carefully managed for the same reason. The fescues can easily be left open to invasion.



## Annual meadow-grass – *Poa annua*



*Poa annua* is purely a ruderal (a weed) that flourishes in conditions of high disturbance. It is solely about invading gaps and quick reproduction. Sustained stress or true competition will see it off. Ruderals are susceptible to disease and drought because they don't invest in a long-term future. Disturbance is key and annual meadow grass will take over a situation involving high mowing pressure, intensive verticutting and heavy wear.

From the diagrams you can also see that annual meadow grass and creeping bentgrass flourish in a similar type of environment. Since we cannot really use beneficial stress, how can we exert selection pressure to keep the meadow grass out without knocking the creeping bentgrass back as well?

## THE UPSHOT

To conclude this section, each turfgrass species is adapted to survive in specific environmental conditions. These conditions must be created for the desired grasses to flourish. To do this we must think in terms of environmental pressures.

We can see that the browntop bents and fescues are C-S-R strategists and they don't welcome too much disturbance pressure but will take a certain level of stress. The annual meadow grass is an R strategist that thrives under disturbance but does not welcome stress. It is clear then that we need to minimise the level of disturbance to favour the finer grasses and use stress as a beneficial selection pressure against the annual meadow grass.

It becomes clear that the intensity and timing of greenkeeping treatments is all-important because of the pressure they exert. As greenkeepers we must think in terms of "setting the environment".

So, what is the current situation?

## THE UK GOLF GREEN ENVIRONMENT

The following table recounts the results of the STRI survey of golf greens carried out in 1995 by Baker, Binns *et al.* Although averages can hide exceptional situations, this table clearly illustrates the sward composition that is currently being produced by modern day greenkeepers in the UK.

Table 2. Species composition in relation to course type. Baker, Binns, Hind, Lodge & Hunt (1995) *J. Sports Turf Res. Inst.* Vol. 71.

Course type	No. of Cases	Ground Cover (%)		
		<i>Agrostis</i>	<i>Festuca</i>	<i>Poa annua</i>
Parkland	67	29	2	63
Links	16	28	8	58
Meadowland	17	18	2	68
Moorland	9	19	0	71
Heathland	8	29	2	58
Seaside	8	25	1	64

Across the different styles of course and their respective environments, it is fair to say that remarkably similar sward compositions are being produced. Annual meadow-grass dominates in all the different types of golf course (even links). Bentgrass has a foothold, although no dominance and limited contribution to playing quality. Fescue is minimal but the averages may be hiding isolated situations where it is quite successful.

The predominance of *Poa* indicates that a highly disturbed, low stress environment is being produced. No surprise. The pressure of play and greenkeeping management practice are dominant and *Poa annua* abounds.

Can this situation be changed in favour a predominance of the finer grasses?

### CHANGING THE NATURE OF YOUR GREENS

To recap, the sward species composition reflects the type of environment being produced. The relative intensity of the various environmental pressures determines the grass types present. The pressures come in the form of disturbance (physical damage), stress (the environmental constraints to growth) and competition (which is not allowed to exert itself in a disturbed situation). To create the desired grass cover we need to set the correct environment. To set the correct environment we need to be able to play with the pressures. The following list shows the influence the greenkeeper has on the level of environmental pressure...

- |                      |   |                                  |
|----------------------|---|----------------------------------|
| • Mowing             | - | Potential high disturbance       |
| • Vertical Cutting   | - | Potential high disturbance       |
| • Wear               | - | Potential high disturbance       |
| • Pest Activity      | - | Potential high disturbance       |
| • Disease Activity   | - | Potential high disturbance       |
| • Aeration           | - | Low to moderate disturbance      |
| • Top dressing       | - | Low disturbance                  |
| • Water availability | - | Potential stress and disturbance |
| • Nutrition          | - | Potential high stress            |
| • Acidification      | - | Potential moderate stress        |
| • Salinity           | - | Potential high stress            |

The golf green environment is intensively disturbed by play, pathogens and pests as well as by the action of mowing and verticutting. It is usually kept stress-free with the application of fertiliser and irrigation to generate recovery and allow the intensive surface preparations to take place. This situation has led to the predominance of *Poa*. You could say that the surfaces are being prepared at the cost of the finer grasses.

I would wager that on the greens where the bents and fescues are flourishing there is another natural overriding or intermittent environmental stress factor occurring (summer drought coupled with poor irrigation, soil acidity or the salinity brought by sea spray during winter storms). Or good greenkeeping of course!

Good traditional greenkeeping technique naturally favours the development of finer grasses because it uses stress occasionally, rather than masking it for the sake of ever more intensive surface preparations. Genuine fine turf comes when the greenkeeper invites a certain level of stress and is canny enough to reduce the level of disturbance. Good greenkeeping is the art of working with the environment. Be sure that the level of stress an expert greenkeeper levers onto the sward will be outside the normal comfort zone, but with experience comes confidence. Good greenkeeping is all about letting go of the looks without sacrificing the playing quality.

#### CHANGING THE SWARD COMPOSITION OF EXISTING GREENS

The received method of increasing the bent and fescue component of a predominantly *Poa annua* sward, would be to impose stress by judicious feeding and watering to pressurise the meadow-grass out. This method is misguided because a highly stressed and disturbed environment is untenable.

We actually need to create a balanced (C-S-R) environment for the finer grasses to survive and *then* incorporate intermittent levels of stress to shift the annual meadow grass out. Essentially, we need to do four things...

- Manage only a moderately pressurised environment trying above all to reduce the level of unnecessary disturbance
- Squeeze-out the annual meadow grass by leveraging stress at the right time
- Interrupt the annual meadow grass reproductive cycle by concentrating on removing seedheads
- Overseed to establish an ever greater proportion of the finer grasses

To reduce the level of disturbance think about the intensity, or even frequency of mowing; toning down incessant verticutting; timing your scarification properly; limiting damaging play during the winter months and keeping on top of pest and disease outbreaks.

Verticutting and scarification is necessary to prepare firm and true surfaces and for annual meadow grass seedhead removal – it just needs to be carried out considerately. After verticutting, wait for natural rather than forced recovery and think of the benefits of less aggressive treatments such as brushing. Time your deep scarification for when the annual meadow grass will not just take advantage.

Surface firmness and trueness can be achieved without undue disturbance by top dressing, the use of low ground pressure rollers, brushing and light verticutting. Speed comes when the surfaces are firm, fine and true so you shouldn't need to mow lower than 5mm. If you back off, the playing surface qualities will come naturally with the finer grasses.

Thatch build up can be controlled with well-timed hollow tining and/or scarification, general aeration, the integration of top dressing and by keeping fertiliser and irrigation inputs to a minimum. Reducing productivity helps reduce the need for disturbance. Traditional greenkeeping gets easier by reducing inputs.

Once the overall disturbance pressure has been softened, we can then lever some stress onto the sward (primarily) by controlled droughting or by limiting fertiliser applications (and possibly in the longer term by acidifying). Be sure to get your dry patch control strategy sorted before going to droughting or you may just be inviting drought disturbance and establishing even more annual meadow grass on the rebound. Fertilise simply to maintain healthy rather than lush growth. Incessant phosphate applications will only help the annual meadow grass reproduce by seed.

Overseed with the finer grasses for germination at the end of the stress period. Let the desired grasses take advantage of the situation. Do your overseeding properly and use quality seed. Remember that the various bentgrass species prefer quite different conditions. Browntop bent likes only moderate levels of stress without too much disturbance, creeping bent can withstand greater disturbance without stress, while velvet bent can withstand moderate stress but little disturbance. Choose your species carefully, let alone the varieties.

Aeration is *the* crucial operation for successful greenkeeping. By relieving soil compaction, aerating the soil and maintaining surface drainage, we reduce the level of negative stress. By keeping the surface open by micro-solid tining in the summer we improve the effectiveness of watering and so reduce the amount and frequency required. By encouraging deeper root development in the finer grasses we increase the stress tolerance of the sward. Aeration frees us up to take better control of the stress factors.

There is a disturbance aspect to aeration and we should be mindful against opening up the surface too much during periods when the annual meadow grass might take advantage. Spring hollow tining, for instance, needs to be well timed.

## MAINTAINING THE ESTABLISHMENT OF A NEW GREEN

Here we are trying to minimise the ingress of *Poa annua* into a predominantly bent and fescue sward. Again, the objective here is to minimise disturbance and try to lever some occasional stress.

Unfortunately, most sand based rootzones aren't that forgiving and so more care is required than for soil based greens. On certain rootzones it may not even be possible to lever any drought or fertiliser stress without damaging the whole sward. It must be said that the flaw of using overtly sandy rootzones is that they don't allow us to play with the stress factors so readily. Choose your rootzone carefully.

Favour the C-S-R by maintaining healthy (rather than lush) growth with appropriate fertiliser inputs. Use your irrigation system to prevent undue stress. Avoid dry patch with the use of wetting agents, aeration and focused hand watering. Keep on top of thatch accumulation with regular top dressing integration into the upper soil profile and by not watering too much. A water soaked turf base stifles the natural breakdown of organic matter.

Do not scarify aggressively at the wrong time or verticut routinely – the *Poa* will take advantage. Maintain sensible heights of cut. Enforce pitch mark repair – the fescue component of new greens makes the surface hard and susceptible to pitch mark damage. Pitch mark scars are a primary mechanism for annual meadow grass invasion in new greens. Close new greens during their first winter and manage winter play considerately thereafter for the same reason.

Above all, MINIMISE DISTURBANCE to keep the annual meadow grass out.

#### ARE YOU FEELING THE PRESSURE?

The sward composition of any golf green simply reflects the environmental pressures being placed upon it. If you want the finer grasses then you have to create the correct environment. I hope you know better now what it takes to establish the finer grasses.

The Head Greenkeeper is in charge of a number of important sources of pressure that can be used to set the correct environment. The site characteristics will place limitations on how far you can go, but I am sure that with considerate management 90% of UK golf greens can support a fine grass dominated sward. You just need to take charge, stick to your principles and wait. Believe me the golfers do appreciate the difference and you certainly will.

Take a look at your greens and see the result of your actions. I hope you can see where the *real* damage is being done. If you see the turf as an environment your maintenance strategy might find the finer grasses. With them you will produce better quality and more sustainable turf. All you have to do is move the environment away from high productivity total disturbance to one more settled with occasional controlled beneficial stress.

Professor Grime's work is an educational tool and I hope it gives you a better starting point when formulating your maintenance strategy.

This article was originally published in Greenkeeper International, April 2002 and was revised in January 2006. I did follow up the original article with "Successful Overseeding" which also needs a second look.

Thanks to Richard Windows, STRI turfgrass agronomist.

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