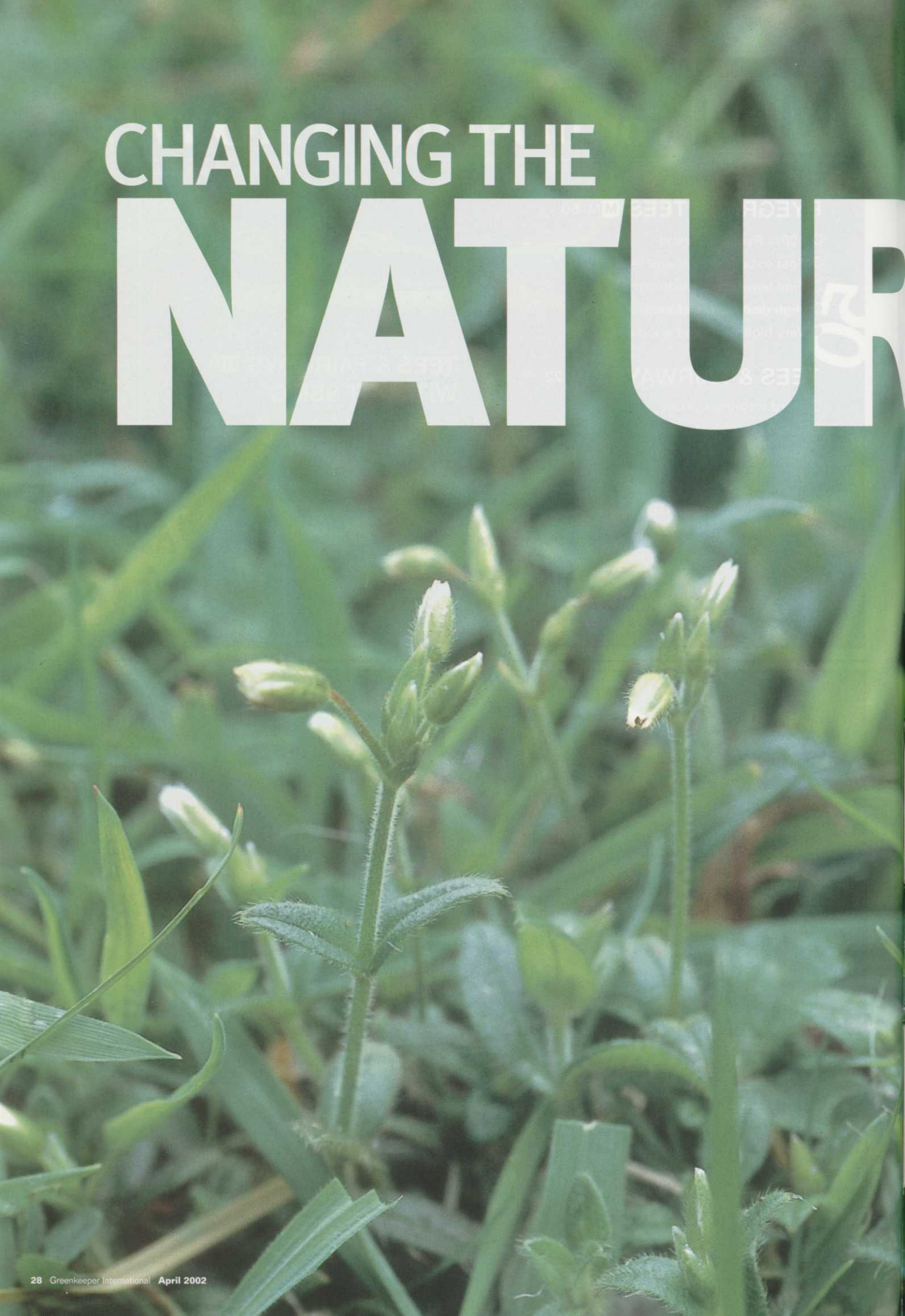


CHANGING THE NATUR





THE GOLF GREEN
 CHANGING THE
 NATURE
 PLANT GROWTH STRATEGIES
 Primary growth strategies
 from the greenkeeper's perspective
 by Henry Bechelet

Henry Bechelet, Turfgrass Agronomist, STRI North East Region discusses the issues raised when changing the type of grasses in your greens

REFLECTIONS OF YOUR GREENS

THE GREATER GOOD

Do you want to change the types of grasses contained within your greens? The objective of this article is to give a greater understanding of the survival strategies developed by the individual turfgrass species. By doing this, I hope to give you the ability to alter, improve or stabilise the quality of your golf greens. 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 can vary in their relative intensities. These pressure factors are described as the three main threats to existence. I make my own interpretations of this parallel work.

THREATS TO EXISTENCE

Stress

Stress is described as the environmental phenomena that restrict photosynthetic production. These are the environmental constraints to growth and regeneration. Stress 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 throughout the year to constrain all species within the environment. Stress factors do not necessarily act in unison, different stresses exert different selection pressures. Greenkeepers have their hands on the reins of certain stress factors, such as fertiliser input, acidification or irrigation.

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, grooming, wear damage, disease outbreaks, pitch marks, divots and pests - not inconsiderable.

Disturbance places a high selection pressure upon the vegetation inhabiting an unsettled environment. Rapid recovery or regeneration is required 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 quantum of light, ion of mineral element, molecule of 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 (unsettled).

Evolution

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 (given a chance). Plant growth strategies have evolved over time to exploit specific environmental conditions to forward the continuation of the species. Nature works in a direction.

The primary growth strategies may be categorised by relating the intensity of stress and intensity of disturbance (external factors) 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)



THE 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. This clearly illustrates the kind of greens that are 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 (%)		
		Agrostis	Festuca	Poa annua
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

Annual meadow-grass dominates in all the different types of golf course (even links). The predominance of Poa indicates that a highly disturbed low stress environment is being produced.

Management pressures

The environmental pressures affecting the golf green may be listed as follows:-

- Disturbance (physical damage) - Mowing, grooming, verticutting, scarification, hollow coring, disease scars, pests, pitch marks, divots, WEAR.
- Stress (environmental limitations to growth) - Not a great deal, although soil acidification should not be forgotten. I also regard soil compaction as a stress factor. Irrigation practice and the regular application of healthy fertiliser programmes maintain a highly productive environment. More northerly courses suffer extended periods of low temperature.
- Competition does not exert itself in disturbed environments although thatch production may well mask the surface.

It is not surprising that Poa is dominating - disturbance abounds!

PLANT GROWTH STRATEGIES

Primary growth strategies

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.)

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 for instance). S-strategists (heather in the wider world, due to soil acidity) 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 clinging on in the face of adversity. Soil acidity is a stress factor that selects, not kills.

Ruderals (**R-strategists**) inhabit low stress, high disturbance environments. Quick reproduction is all-important. Ruderals (weeds) are 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. Preservation and development of the species is the singular imperative for such volunteers.

Competitors (**C-strategists**) develop within low stress, low disturbance, settled environments. 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.

Competitive ruderals (C-R) are adapted to moderate (or infrequent) 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.

Conclusion to growth strategies

- The environment is governed by the three types of pressure
- Plants have adapted to survive in specific environmental conditions
- The vegetation reflects the nature of the environment
- The grass species present within a green are a reflection of the environment you have helped create

So are we creating the correct environment? Does the greenkeeping favour the desired grass species? If not, can we change the environment to allow the finer grasses to predominate?

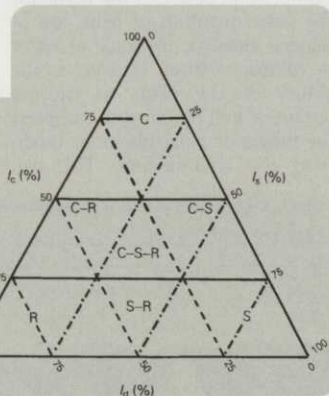


FIGURE 1. A Model describing the various equilibria between competition, stress and disturbance in vegetation and the location of primary and secondary strategies. C, competitor; S, stress-tolerator; R, ruderal; C-R, competitive-ruderal; S-R, stress-tolerant ruderal; C-S, stress-tolerant competitor;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

FEELING THE PRESSURE?

The sward composition of a golf green reflects the pressures being placed upon it. The Head Greenkeeper is in charge of a number of important sources of pressure. Beneficial pressures can be used to manipulate the environment in favour of the more desirable turfgrass species. Poa is favoured by disturbance and, to a large degree, this stems from the pressures

of play, but do not underestimate the influence of your actions. The finer grasses need a more settled environment to take over.

Professor Grime's (and others) work is an educational tool and I hope it gives you a better starting point when formulating your maintenance strategy. Next stop regenerative strategies and successful overseeding.



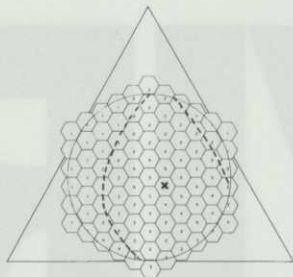
THE FINE TURFGRASSES

The golf green is the most important surface on the golf course - the place where the game is won and lost - and must be perfect! The modern golf green is an intensively maintained environment subjected to intensive play throughout the year. Still, the surface must remain consistently fine and true for putting yet receptive enough to receive and release approach and chip shots. The greens must also be able to tolerate the traffic of the golfer who insists on year-round play.

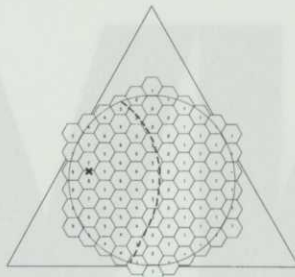
The sward species composition has a great bearing on both the playing quality and wear tolerance of any turf. With regard to golf greens: fescue (*Festuca*) produces hard and fast putting surfaces that bounce an approach shot forward - wear tolerance declines in the winter; bent (*Agrostis*) produces fairly fast and true putting surfaces that are also receptive to approach shots - the surface is fairly wear tolerant throughout the year; annual meadow-grass (*Poa annua*) tends to produce softer surfaces that can be made into "good summer greens" but suffer from thatch build up and disease susceptibility. As we will see, each turfgrass species is adapted to survive in markedly different conditions.

The growth strategies of the fine turfgrass species

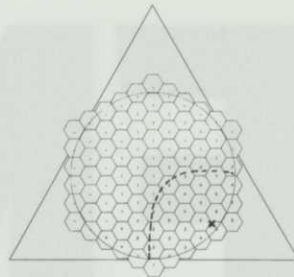
This section will illustrate the specific environmental conditions that the various turfgrass species have evolved to exploit. Remember that the greenkeeper is in charge of a number of the external pressure factors.



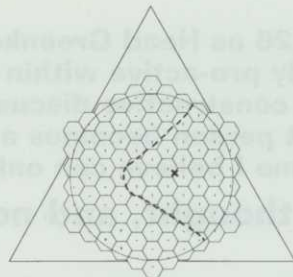
Browntop bent - *Agrostis tenuis*
C-S-R strategist adapted to compete in an environment characterised by moderate levels of stress and disturbance. Prefers acid soils.



Creeping bent - *Agrostis stolonifera*
CR strategist adapted to moderate or infrequent levels of disturbance and low levels of stress. Needs active growth to be able to recover from disturbance.

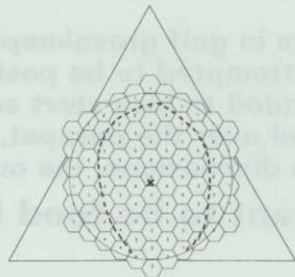


Sheep's fescue - *Festuca ovina*
Stress tolerator, exploits conditions of low disturbance and high stress. May be of use.

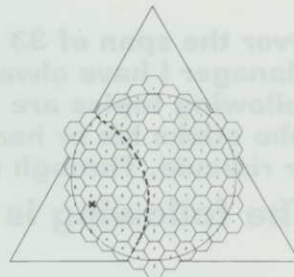


Velvet bent - *Agrostis canina*
C-S-R strategist competes with moderate levels of stress and low levels of disturbance. Does not take kindly to winter play.

(Note: 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.)



Red fescue - *Festuca rubra ssp. rubra*
C-S-R strategist adapted for moderate intensities of stress and disturbance. Red fescues flourish during the summer. Slow to recover from damage leaving gaps for invasion.



Annual meadow-grass - *Poa annua*
Poa annua is a ruderal favouring conditions of high disturbance and low stress. Disturbance is key but *Poa* does not welcome acid soil conditions

In conclusion, each turfgrass species is adapted to survive in markedly different environments. To flourish and survive they therefore require specific management.

CHANGING THE NATURE OF YOUR GREENS

The sward species composition reflects the type of environment being produced. The relative intensities of the various environmental pressures determine the vegetation types present. The golf green environment is intensively disturbed by play, pathogens and pests, as well as by the action of refinement and it is kept stress-free to allow for the intensive maintenance. This situation has led to the predominance of *Poa*. If you wish to change the composition of a green, you must create the conditions that the finer grasses would prefer.

As we have already seen, green-keeping is in charge of a number of significant sources of environmental pressure:-

- Mowing - intensity and frequency
- Verticutting, etc - timing and severity
- Integrated pest and disease management
- Irrigation
- Fertiliser input
- Acidification
- Course/green closure

These actions should be undertaken considerably to manipulate the environmental pressures to suit the desired grass species.

Changing the sward composition of existing greens

To increase the bentgrass component of predominantly *Poa* greens, for the sake of argument, the received method of attempting this would be to impose stress on the sward (by judicious feeding and watering) to pressurise the meadow-grass out. By this theory, such a method is misguided if you refer back to Table 1, which clearly states, "a highly stressed and disturbed environment is untenable".

To reduce the dominance of the meadow-grass and increase the bentgrass component we must firstly reduce the level of disturbance (limit the overall pressure). This may be achieved by reducing the intensity and frequency of mowing, toning down all forms of verticut-

ting (use a brush to groom), limiting play during the winter months, etc. Once the disturbance pressure has been softened, we can then lever some stress onto the sward by acidifying, or by limiting fertiliser applications and certainly regulating irrigation inputs. We must move the environment away from the area of *Poa* dominance, from total disturbance to settled stress. Thatch build up can be controlled with micro hollow tining and top dressing. Surface trueness can be retained using top dressings and low ground pressure rollers. Modern aeration equipment is quick, effective and non-disruptive.

When setting the environment, remember that the various bentgrass species prefer quite different conditions. Browntop bent requires only moderate levels of stress and disturbance, creeping bent can withstand greater disturbance without stress, while velvet bent can withstand moderate stress but little disturbance. Choose your species carefully.



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, MINIMISE DISTURBANCE AND LEVER STRESS. Do not aggressively verticut or groom - the *Poa* will take advantage. Maintain sensible heights of cut. Use your irrigation system to your advantage. Prevent thatch accumulation with regular top dressing integration into the upper soil profile. Enforce pitch mark repair - the fescue component of new greens makes the surface hard and susceptible to pitch mark damage. Close new greens during their first winter. Annual meadow-grass will take advantage of any gaps in the sward. Acidify if necessary.

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