

# CONTROLLING THE ARCHITECTURE OF GRASS STANDS

## OPTIMISING THE PERFORMANCE OF PERMANENT GRASSLANDS THROUGH PLANT GROWTH KNOWLEDGE

Permanent grass stands that are characterised by a low shoot density and many gaps encourage the growth of agronomically undesirable species. These undesirable plants are traditionally prevented by such established techniques as harrowing and reseeding high-performing grass species. However, the long-term performance of highly productive permanent grassland is contingent on the type and intensity of the grassland management, because the intensity of grazing or cutting has a major influence on the growth processes of the grass plants.



Not only is permanent grassland an excellent source of forage for dairy cows, horses and sheep but it also makes a significant contribution to the ecosystem by providing carbon reserves and habitat for a diverse flora and fauna, (Plantureux et al., 2005). Yet, this habitat is destroyed by mechanical rejuvenation techniques such as ploughing or power harrowing; apart from this, these methods lead to a mineralisation of the sensitive carbon stores in the soil. This can lead to a significant release of climate changing emissions and to a loss of nitrogen, each of which has a negative impact on the environment (Reinsch et al., 2018). But also from the point of view of business viability, it is important to maintain the high productivity of permanent grassland over a long term, which can be achieved by applying alternative measures, especially as ploughing and reseeding are a costly measures. Among such alternative measures is the consideration of growth processes and grassland management.

### Tillering in grass plants

Grass species have developed a wide variety of mechanisms to reproduce vegetatively by forming stolons, rhizomes and tillers. For example, white bunchgrass (*Agrostis stolo-*



Grassland that is exclusively cut shows a low shoot density, especially after the first cut in the spring. This increases the risk of undesirable plant species invading into the stand.



Intensively farmed grass stands show a higher shoot density, for example in intensive grazing systems.

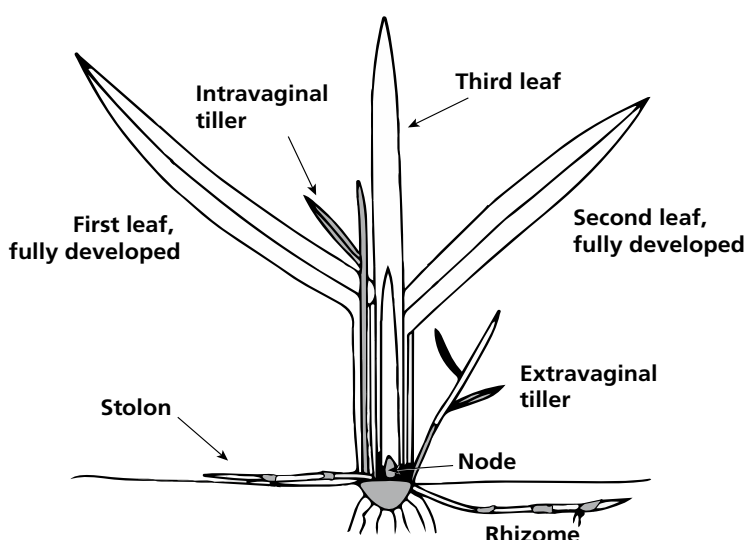
nifera) forms stolons („creeping shoots“) at ground level. Meadow-grass (*Poa pratensis*), on the other hand, develops underground rhizomes. The agronomically most important and also most intensively farmed German ryegrass (*Lolium perenne*) reproduces vegetatively by tillering (Figure 1). This species has a very adaptable morphology, which makes it possible to influence the architecture of the stand by changing the type and intensity of farming. This is particularly effective in ryegrass-dominated stands.

In suitable conditions, tiller buds along the leaf axes of a parent shoot are able to produce lateral shoots of which some develop into new and independent parent shoots which in turn start tillering themselves. Consequently, a stand of grass is the summary of a multitude of parent shoots and tillers, each of which representing a different stage of growth. Good light conditions at the base of a shoot have a positive effect on side tillering, activating tiller buds, inducing the growth of side tillers and ultimately promoting a dense sward (Nelson & Moore, 2020).

### The impact of phenology

Stands that are harvested by cutting show less tillering in the first generative and tall growth. Here, only little light reaches the tiller buds that are closer to the ground, which keeps them dormant to the effect that no tillering is induced. Cutting such a tall stand typically leaves the residual plant with hardly any photosynthetically active leaf mass, so that its regeneration solely depends on the energy reserves that are left in the stubble and in the roots. This translates into a reduced growth potential (Figure 2).

FIGURE 1: SEQ ILLUSTRATION



\* ARABIC Illustration of a grass culm with extra- and intravaginal shoots, stolon and rhizome (modified according to Nelson & Moore (2020)).

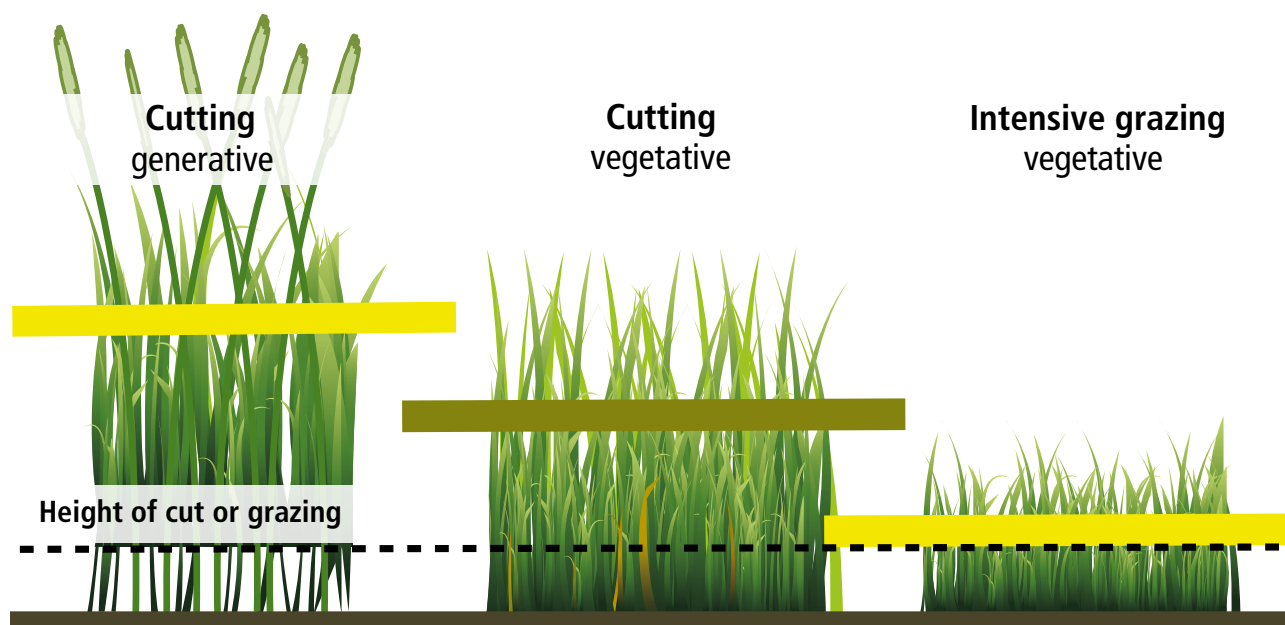
Consequently, the following vegetative stands will develop only few and isolated generative tillers, so that a higher proportion of photosynthetically active leaf mass is present after the cut, thus ensuring faster regeneration. However, it is essential that this cut is not carried out at a late stage. Should this be the case, the oldest leaves in the lower layer will senesce and hence will not be photosynthetically active (Figure 2).

### The influence of grazing/ cutting intervals

Most grasslands that are farmed intensively form three green leaves in the vegetative stage. When the fourth leaf develops, the oldest leaf at the lowest level dies. An optimised grazing management therefore aims at grazing the stand when this is in the 3-leaf



FIGURE 2: PENETRATION OF LIGHT INTO THE GRASS STAND DEPENDING ON USE



The illustration shows the penetration of light into the grass stand, the height at which a stand is cut or intensively grazed and the photosynthetically active grass mass that is left after the cut or grazing (red grass blades = senescent leaves).

stage and keeping the grass generally short throughout the entire vegetation period (Fulkerson & Donaghy, 2001). On the one hand, this ensures the animals take in young plants that are rich in energy and protein, and on the other hand, it allows light to reach the lower layers of the stand and stimulate til-

lering. Furthermore, German ryegrass, which is an adaptable grass crop, tillers very close to the ground in intensive farming schemes, which creates a dense and tread-resistant sward (Gautier, 1999). Consequently, tillering in intensively grazed pasture stands can lead to up to 30,000 shoots per square metre. This

should be compared with a shoot density of 8,000-12,000 shoots per square metre in stands that are exclusively cut – an adequate supply of nutrients and water provided (Orr et al., 1988).

### Summary

In intensively farmed permanent grassland, the intensity of cutting/grazing can influence tillering and thus the shoot density in the stand. This can ultimately impact the resilience of permanent grassland and its ability to cope with external disturbing factors. Thus, under the right conditions, grazing permanent grassland that is usually cut may have a vitalising effect and contribute to a persistent and productive sward. —



### Literature

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