

# **To gibbon or not to gibbon?**

## **The FAQ's about gibberellic acid**

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### Introduction

Gibberellic acid (GA) presents an opportunity for farmers to increase pasture production on the shoulders of the lactation season when pasture growth rates are typically low. Furthermore, GA can also be used as a strategic tool to reduce nitrogen losses by replacing an N application with GA instead. Response of pastures to GA can vary from 0 to over than 1000 kg DM/ha in a single regrowth (Matthew et al. 2009), though much of the variability can be managed to obtain a more consistent pasture response. The purpose of this workshop is to address some of the frequently asked questions (FAQs) around GA use and examine how the effect of GA on pasture species may improve or limit pasture response to gibbon.

### What is gibberellic acid?

Gibberellic acids are growth hormones commonly found in flowering plants, as well as fungi and bacteria. Over 100 gibberellins have been identified, with each gibberellic acid given a number according to the order in which they are discovered eg GA<sub>1</sub> to GA<sub>136</sub>. The GA used in farming today is GA<sub>3</sub> and although it is produced by a fungi it has bioactive properties when applied to plants. In plants the role of gibberellins in regulating growth often includes elongation of leaf and sheath, 'switching off' dormancy, early flowering and lateral branching (Marth et al. 1956). In grasses and cereals, elongation of leaf, sheath and stem is commonly observed following treatment with GA, along with yellowing of leaf. The effects can often be seen in a matter of days, but tend to be less visible after 2-3 weeks. There is still a great deal that science doesn't know about gibberellins, and much of the uncertainty arises from interactions between the various GA's and other plant hormones. Thus it is not always easy to predict how different plants will respond to GA<sub>3</sub> when applied exogenously.

### How does perennial ryegrass respond to gibbon?

The effect of GA on perennial ryegrass is primarily associated with seasonal changes in day length and temperature. Provided the pasture has been vernalised (ie been exposed to winter conditions of short days and cold nights) most users can expect to see a response to GA when applied in late winter, early spring and autumn (Zaman et al. 2013, van Rossum et al. 2013). Applying GA in late winter replaces the need for accumulated long days to initiate stem elongation. As the number of long days increases, the plants themselves produce enough of their own GA (MacMillan et al. 2005) so GA applied in late spring or summer is unlikely to illicit much response. This was demonstrated by Ball et al. (2012) and in a study carried out at Lincoln University to determine the effect of timing of GA application in late winter and spring on ryegrass-clover pasture response. In this study N fertiliser (25 kg N/ha) was replaced with a single application of GA either at the beginning of August, September or October. The accumulated DM yield from 1 August to 1 November each year are presented in Figure 1 and demonstrate a lower DM response from perennial ryegrass in the October application. Though, increased response of clover from the late application compensated for the reduction in ryegrass yield. The greatest DM yields were obtained from applying GA and N together and this effect has been observed in several studies (Ball et al. 2012; van Rossum et al. 2013; Zaman et al. 2013; Matthew et al 2009). Availability of N at time of application has shown to improve pasture response to GA and this is the result of increases in both tiller size and tiller density. However, as pressure mounts to reduce N inputs, the option of using GA instead of N fertiliser to reduce total N inputs presents some promising opportunities to maintain pasture productivity early or late in the season.

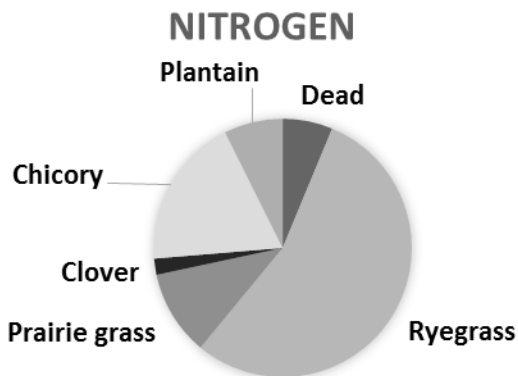
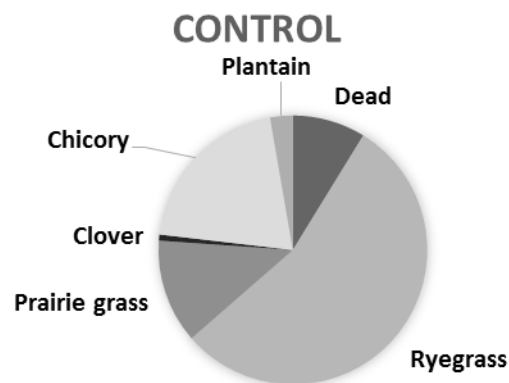
Figure 1. Accumulated DM yield from three harvests between September and November following applications of GA either in August, September or October in Canterbury (Miller, Bryant, Hague and Edwards unpublished).

#### How do clovers and other species respond to gibb?

Perennial ryegrass, while responsive to GA is not the only plant species whose growth is promoted by GA. White clover is very responsive to GA (Finn et al. 1959), as is tall fescue and many broadleaf weeds including dock. A study carried out at Lincoln,

applying GA to diverse pastures in autumn, revealed an increase in diversity after GA was applied (van Rossum et al. 2013), with the chicory and legumes being most responsive to GA. After treatment with GA, diverse pastures contained a higher proportion of herbs and legumes compared with control or N fertilised pasture (Figure 2). If weeds make up less than 5% of the pasture sward, application of GA should not be detrimental, competition from other responsive plants are able to prevent large

fluctuations in



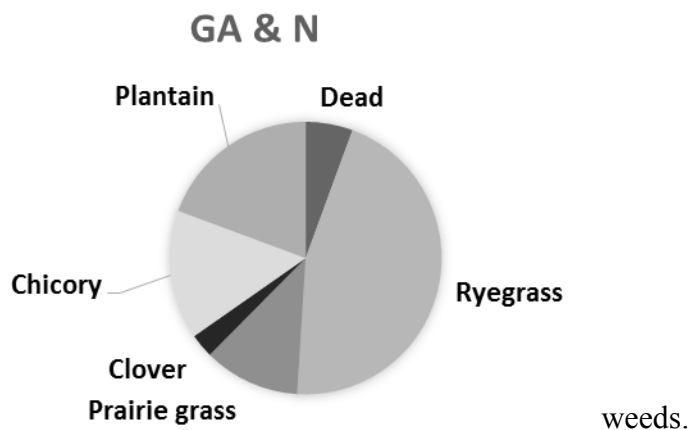
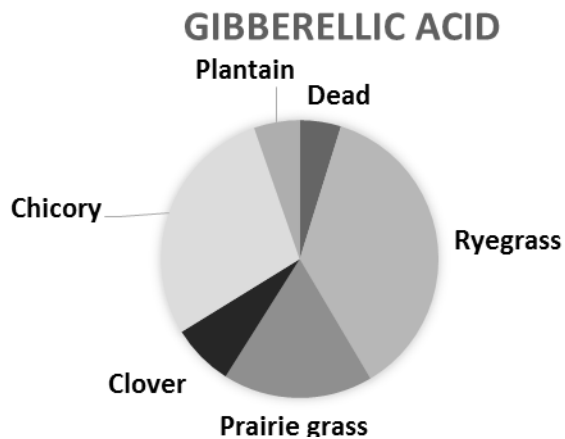


Figure 2. Effect of gibberellic acid (GA) and nitrogen application on botanical composition of diverse pastures in autumn. (From van Rossum et al. 2013)

Because of the positive effect of GA on clover, the nutritive value of the pasture is often maintained or improved following GA application. The effect of GA on ryegrass alone has shown reductions in herbage crude protein content, increased water soluble carbohydrates and fibre (NDF) and lower ME depending on stage of harvest. A study by Miller (2010) investigating milk production in autumn of cows consuming the same amount of either GA or N-treated pastures found no difference in milk yield (1.45 vs 1.42 kg MS/c/day for GA and N respectively). However, in pastures with little or no clover, GA application has the potential to reduce ME content of grasses through increased fibre concentration.

### Can I apply gibb more than once?

There is evidence to suggest that successive applications of GA without N fertiliser will reduce tillering in ryegrass (Bryant et al. unpublished) which may lead to reduced pasture production in grass dominant swards. However, if clover is present, successive applications of GA may minimise the impact by increasing clover production which appears to benefit from either the GA or lower tiller density or a combination of both (Table 1, Figure 1). Table 1 below shows that after two applications of GA in spring (with no N fertiliser) resulted in a reduction in tiller numbers. Total yield was maintained through larger tillers and more clover.

Table 1. Effect of first and second N or gibberellic acid (GA) applications on mown harvest pasture and clover yields (kg DM/ha) and tiller density (tillers/m<sup>2</sup>).

	<b>First application</b>			<b>Second application</b>		
	Total yield	Clover yield	Tiller density	Total yield	Clover yield	Tiller density
<b>Control</b>	1329	489	8038	536	106	10475
<b>N</b>	2076	432	11800	837	104	13050
<b>GA</b>	1662	602	9825	861	277	5950
<b>SED</b>	182	130	1112	94	42	1754

From van Rossum (2013)

A current study at Lincoln University is investigating the effect of multiple applications of GA on pasture production by applying two, four or six applications of GA a year, (half in spring and half in autumn). The results of the first year show there was no negative effect from as many as 10 applications of GA when applied with simultaneously with N (Figure 3). However, if GA was used to replace N, total pasture yields declined at the rate at which N was omitted – however, even up to six GA applications a year did not result in pasture production dropping below that of the control which received no GA or N.

Figure 3 The effect of multiple applications of gibberellic acid (GA) and nitrogen on accumulated annual dry matter yields above mowing height. (Miller, Bryant, Hague and Edwards unpublished)

Is there a lag phase after grazing gibb-treated pasture?

A lag in regrowth after grazing GA-treated pastures is common, but avoidable. The issue with early spring pasture is that it has high pasture mass and low tiller density due to shading at the base of the sward results. Once grazed these pastures have little or no leaf area so regrowth is slow. Exposure of the base of the sward to light after grazing encourages tillering and clover growth. Applying GA without N to these winter pastures in the first spring rotation can slow down this process of tillering, even though you can expect a yield response from increased tiller size, subsequent regrowths may be slower (see Figure 1 year 2012). Because GA application results sheath elongation and increased tiller size, the hard grazing which often follows, results in an almost complete loss of leaf area and a long lag phase regrowth from a relatively low tiller population.

The best responses to GA occur when N is not limiting and when pastures are not grazed too severely. Nitrogen availability can be addressed either through applying N simultaneously with GA or using GA or N in consecutive regrowths. Applying GA to grazed pasture with a greater leaf area has also shown to improve the response to GA when N is not limiting (Bryant unpublished). Plants which had lax defoliation (8 to 9 clicks of the plate meter) had greater tiller numbers after GA compared with hard defoliated plants (6-7 clicks on the plate meter). After GA is applied the regrowth time should allow two to three leaves to appear before grazing, as it is not until that two and a half leaf stage the plant is much better equipped to deal with hard grazing (Ball et al. 2012). Once the pasture is ready to be grazed, the aim is then should be to graze lax again.

Lax grazing in spring does not necessarily mean speeding up the rotation - although this may happen anyway as growth rates are expected to increase following use of N and GA. When using the spring rotation planner, increase the target post grazing residual to 1700 kg DM/ha. This will mean a higher target pre grazing mass in the feed wedge predictions but given that the rising plate meter tends to overestimate

mass of pastures treated with GA using those higher values and setting higher pre and post targets is likely to make pasture management easier.

### Summary

Using GA together with N in late winter/early spring and autumn can be used successfully to increase pasture production. Clover benefits from GA application and increased yield from late applications may occur from clover rather than ryegrass. Strategic use of GA instead of N to increase pasture growth in the shoulders of the season may present an opportunity to reduce N use without compromising pasture production.

### To gibb or not to gibb checklist

- Pasture should have been through at least one winter
- Ensure pasture is relatively weed free
- Pasture should have sufficient soil moisture and N to support extra growth
- Gibb can be applied up until mid September (Canterbury) or mid October (Southland)
- When applying gibb in early spring without N, check the size of gaps between tillers, if tiller numbers and clover plants are low, delay gibb until the next grazing or apply a small amount of N instead
- Try to avoid hard grazing prior to and after gibb application
- Allow pastures to reach the two and a half leaf stage before grazing
- Apply at the rate and within the time frame that is recommended on the label
- Apply with nitrogen for best results

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