5.2 BOOSTING PHALARIS WINTER GROWTH USING NITROGEN & GIBBERELLIC ACID

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KEY MESSAGES

- Nitrogen and gibberellic acid can be used to boost winter growth of phalaris by an additional 275 kg DM/ha.
- Nitrogen was not limiting pasture production in winter 2024 due to sufficient levels of soil nitrogen, however pastures did respond to the addition of urea during September when the plants were actively growing.
- Gibberellic acid is currently a more cost-effective option for boosting winter growth than urea, due to the high price of urea and the ability to grow additional feed within four weeks of application in winter.
- Australian phalaris had the lowest winter production due to its semi winter dormancy trait, however, it showed good responses to gibberellic acid.
- Gibberellic acid treatments resulted in less dry matter produced in the spring, which is generally not a concern as available feed in other pastures is unlikely to be limited in spring. This might be a concern if you wish to use this pasture for silage or hay production.

Keywords: pasture, phalaris, urea, gibberellic acid, winter growth

BACKGROUND

This report focuses on boosting phalaris winter growth with gibberellic acid (GA) or urea and seeing if there is a varietal response. The response of an existing semi-winter dormant Australian phalaris-based pasture versus the response from newer, younger established (2022) winter active phalaris varieties. The trial was conducted at the SFS Rokewood site.

Applications of nitrogen (N) can help grow extra feed in times when soil available nitrogen is limited, and the plants are actively growing and have high nitrogen demands. Responses to nitrogen are going to be highest in spring and lowest in winter when cold temperatures and excessively wet conditions inhibit growth. However, excessively dry conditions and low soil fertility will also impact nitrogen responses (McKenzie, 2001).

Nitrogen application rates of 15 to 60 kg N/ha will elicit the best responses, given that all other factors are not limiting. The best response from nitrogen applications is to apply to improved pastures, soon after grazing (1200 to 1500 kg DM/ha) as active growth occurs in the first two weeks after grazing and the plants may be limited by nitrogen (McKenzie, 2001).

Gibberellic acid is a naturally occurring hormone that stimulates cell expansion resulting in leaves and stems becoming longer. It becomes depleted in plants during cold temperatures and as such responses can occur in winter (Ag Vic, 2024). Applications work best when soil fertility is adequate, and the paddock is spelled for 2-3 weeks post-application. To get the most out of the extra growth, apply in late June–early July. The maximum response from the application will occur after 3-4 weeks but may continue to have an effect for another four weeks. Phalaris pastures are most responsive to gibberellic acid, perennial ryegrass is less so, requiring higher rates (20 g/ha) and applications on annual ryegrass may reduce subsequent recovery. Tall fescue is not responsive to gibberellic acid.

METHOD

The existing pasture on the site consisted of old Australian phalaris. Four newer winter-active varieties of phalaris were sown on 13 May, 2022 (Holdfast GT, Confederate, Horizon and GT070) to compare to the existing phalaris pasture. Strips of gibberellic acid and urea were applied in July 2024 across all five phalaris treatments (Table 1). For further information on establishment methods and trial management refer to "Is it worth replacing old Australian phalaris with new winter active cultivars?" in the 2023 SFS Trial Results book.

Climatic Conditions

The rainfall for May to June 2024 was well below the median for Rokewood. See Climate and Soil Data in Chapter 6.

Growth Promoter Application

Gibberellic acid was applied to range one of the trial and urea was applied to range two of the trial on the 29th of July 2024 to a two-year-old pasture. Gibberellic acid was applied using a hand-boom with a water rate of 100L whilst the urea was spread by hand. Rates can be found in Table 1. The pasture height at the time of application was ~7 cm (Figure 1).

Table 1. *Growth promoters applied in 2024 to trial ranges 1 and 2 only.*

Product	Rate/ha	Application Date
Gala (100 g/L Gibberellic acid)	40 mL (4 g active ingredient/ha)	29-July-24
Urea	87 kg	

Figure 1. Phalaris height at the time of application (29-Jul-24).

Measurements

Pasture production was collected using a ride-on mower with a built-in weighing system to measure standing pasture in each plot. A hand-cut sub-sample was also taken, weighed and dried to measure moisture content. The two measurements were used to determine the kg DM/ha for the treatment. Cutting occurs when pasture is about 2000 kg DM/ha (approximately 10 cm) to a residual height of 5 cm. The trial was cut four, eight and 17 weeks after the growth products were applied.

RESULTS & DISCUSSION

The growth response was measured at four and eight weeks to help determine which product provided the quickest growth rate late winter-early spring. Another cut was done 17 weeks post application to look at the late spring-early summer effects of the application.

Gibberellic acid increased dry matter production after four weeks across all phalaris varieties (Figure 2). Horizon responded the best to gibberellic acid compared to the other varieties, followed by Australian and then Holdfast GT. GT070 had the lowest response to both gibberellic acid and urea.

Gibberellic acid had the greatest effect on dry matter production after four weeks, producing an additional 275 kg DM/ha compared to the untreated (Figure 3). Gibberellic acid had little effect after the initial four weeks, increasing growth by only 15 kg DM/ha at the eight-week measurement compared to the untreated. The advantage of using gibberellic acid is that the plant responds in three to four weeks, which is quicker than waiting for a response to urea, which with cold temperatures, can take four to six weeks before growth can be observed or grazed.

On average, urea did not produce any additional response within the first four weeks of application. This may have been a result of high soil nitrogen levels that had accumulated during the dry conditions and therefore nitrogen was not limiting production. In average rainfall conditions this nitrogen would have normally been used in autumn for growth, but because of dry autumn and early winter conditions there was little pasture growth to use up the nitrogen mineralised from last year's excess feed and no summer rainfall to leach nitrates. As the pasture responded to gibberellic acid, it can be assumed moisture was adequate however the cold temperatures also probably limited growth.

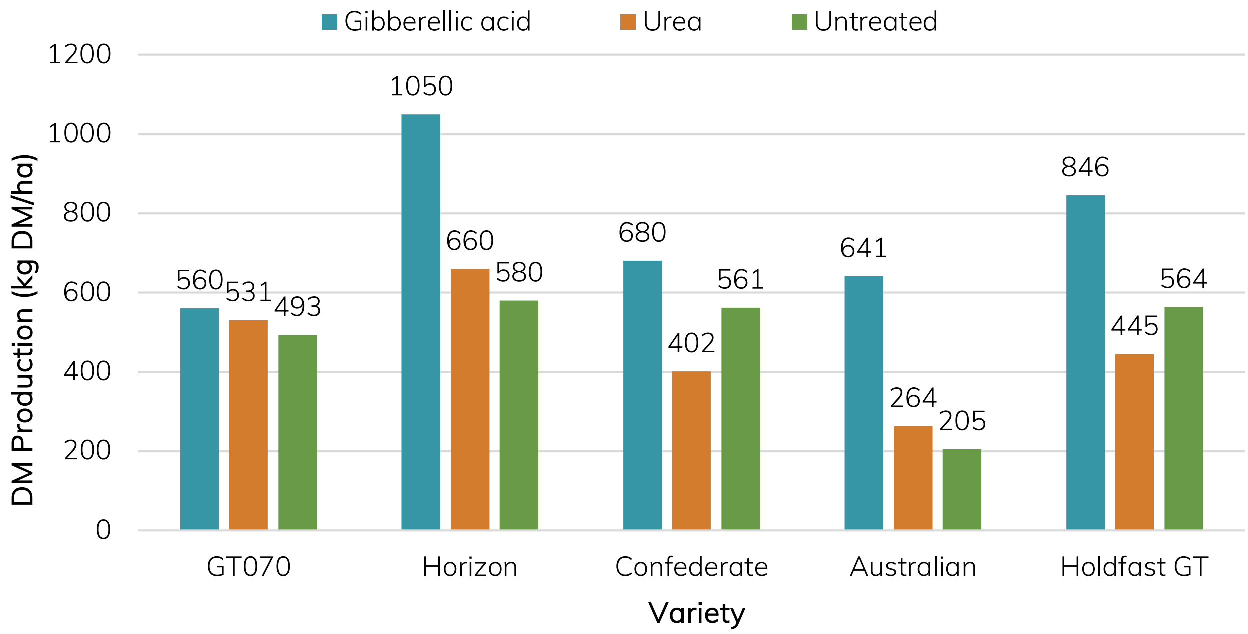

Figure 2. Dry matter (DM) production (kg DM/ha) four weeks after application for each phalaris variety.

After eight weeks, urea did increase dry matter production, by 277 kg DM/ha compared to the untreated. This additional growth is most likely in response to high plant demand at this time when soil temperatures were increasing. The urea results highlight the importance of not assuming nitrogen will always give a response. Soil testing and checking soil ammonium and nitrate levels can help guide nitrogen decisions. Generally, combined ammonium and nitrate levels above 10 mg/kg are preferred for pasture production (Botta, 2015). Soil tests for the paddock taken in December 2023 show combined nitrogen levels of 17 mg/kg (Table 5). Soil test results taken at the end of 2024, following the treatments show some variability in the soil which could be due to sampling urine or dung patches or normal soil variation (Table 6). The higher levels of combined soil nitrogen on the control, are possibly due to less uptake due to reduced growth compared to the gibberellic acid and urea treatments or possible urine patch sampling. Phosphorous and potassium were at levels not expected to limit pasture production.

Table 3 shows similar results, that on average the additional dry matter production of all winter active phalaris treated with gibberellic acid was 234 kg DM/ha four weeks after application. In comparison, urea on average produced only an additional 29 kg DM/ha. This equates to an additional 0.73 kg DM/ha per 1 kg/ha of urea applied. This is much lower than what would occur in more 'normal seasons' with adequate moisture for plant growth as reported in previous studies (Menhennett, 2022) that found responses of an additional 7-8 kg DM/ha during August.

Eight weeks after the initial application, and four weeks after the last cut, urea produced an additional 307 kg DM/ha, equating to an additional 7.7 kg DM/ha per 1 kg N/ha applied, and gibberellic acid only an additional 39 kg DM/ha. This additional growth from urea supports Menhennett's findings (2022), with the warmer temperatures experienced in September resulting in increased gibberellic acid content within the phalaris plants and nitrogen becoming the limiting factor.

Table 5. Soil test results (sampled December 2023).

	Ammonium Nitrogen (mg/kg)	Nitrate Nitrogen (mg/kg)	Phosphorus Colwell (mg/kg)	Potassium Colwell (mg/kg)
Trial Paddock	5	12	35	270

Table 6. Soil test results (sampled December 2024).

Treatments	Ammonium Nitrogen (mg/kg)	Nitrate Nitrogen (mg/kg)	Phosphorus Colwell (mg/kg)	Potassium Colwell (mg/kg)
Control	32	10	52	320
Gibberellic Acid	15	21	46	311
Urea	17	17	54	253

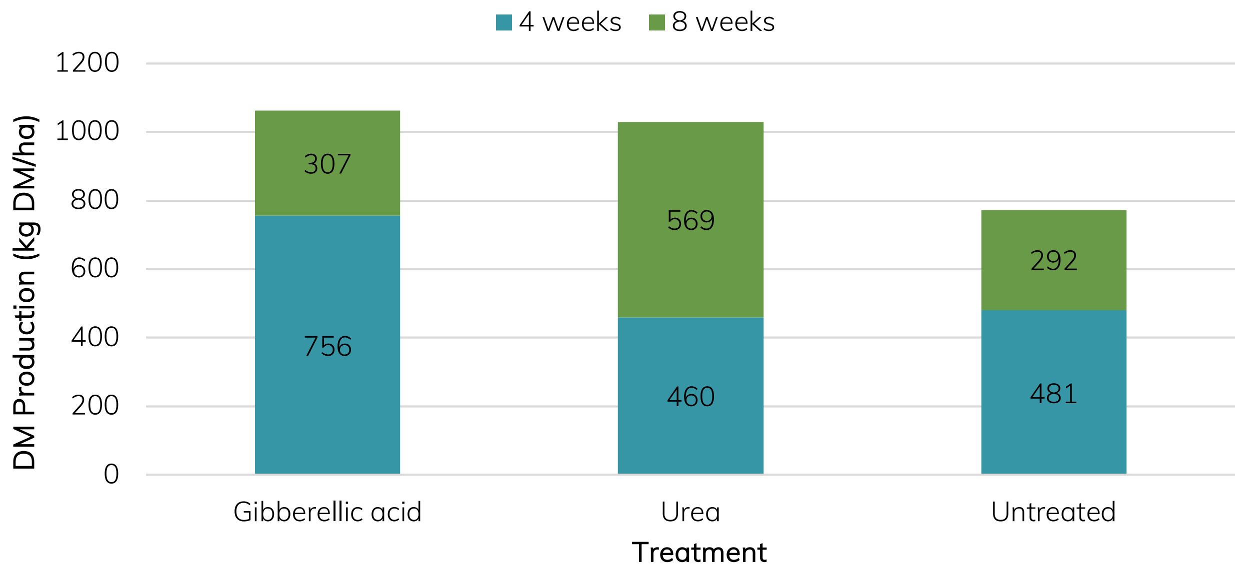

Figure 3. Average dry matter (DM) production (kg DM/ha) of gibberellic acid and urea strips in comparison to the average growth of all untreated plots.

Table 3. Additional growth (kg DM/ha) four and eight weeks after production application in comparison to average untreated winter active phalaris varieties. Regrowth is the additional dry matter grown after the trial was mown at four weeks.

	4 weeks		8 weeks		Regrowth	
Treatment	**Gibberellic Acid**	**Urea**	**Gibberellic Acid**	**Urea**	**Gibberellic Acid**	**Urea**
GT070	+67	+37	+50	+225	+123	+126
Horizon	+471	+80	+71	+162	0	+174
Confederate	+119	0	+243	+231	0	+150
Holdfast GT	+282	0	+116	+354	+35	+780
Average (winter actives)	+234	+29	+120	+243	+39	+307
Australian	+436	+59	+147	+208	+83	+154

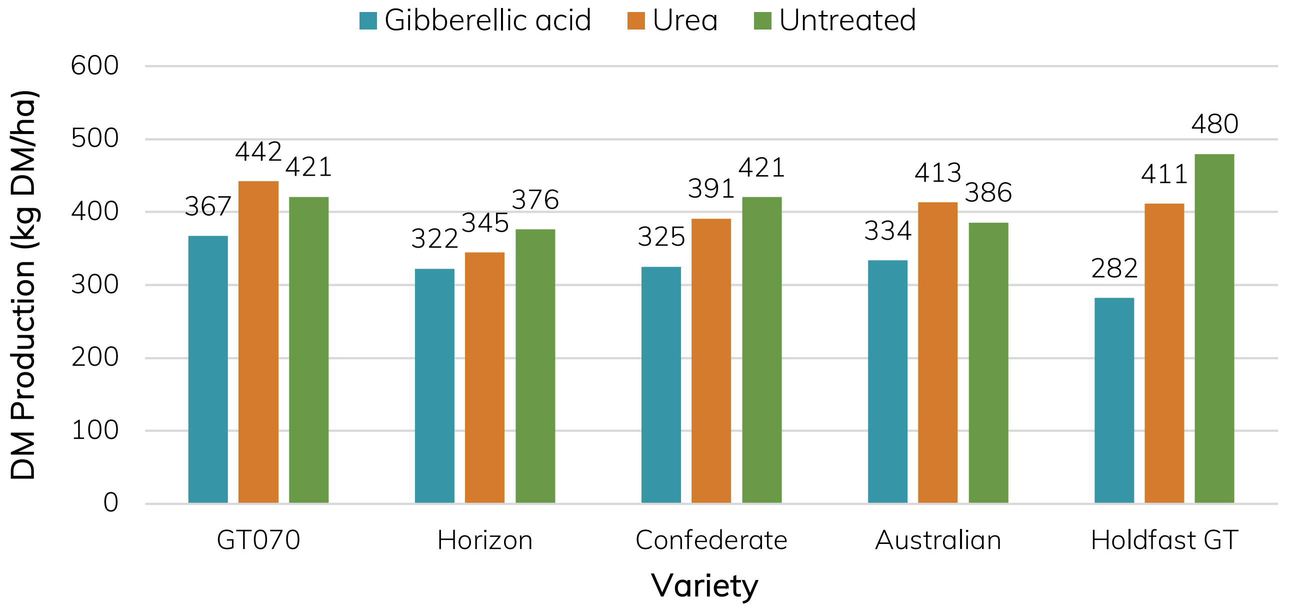

Figure 4. Late spring dry matter (DM) production (kg DM/ha) for all phalaris varieties. The trial was cut on 4th December 2024, 17 weeks after treatments were applied.

The response to gibberellic acid in 2023 was less than the increase seen in 2024, with Horizon not responding in 2023 but in 2024 produced an additional 471 kg DM/ha (Table 3). This is likely because the pasture is older and denser and has more capacity for growth. The Perennial Pasture System's group found the best responses to gibberellic acid were related to phalaris density and where phalaris exceeded up to 50% of the sward (Shea & Campbell, 2019). Urea had a greater response in 2023, producing an additional 119 kg DM/ha compared to only 29 kg DM/ha in 2024, this poor result for 2024 is more than likely linked to lack of soil moisture (Table 6).

Another cut was taken on the 4th of December 2024, 17 weeks after treatments were applied, shown in Figure 4. All phalaris varieties that were treated with gibberellic acid in the winter produced less dry matter in the spring. It is possible that by using the plant reserves for growth in late winter, there was less available for spring growth. Although there is limited research to support the claim, agronomists often use the logic that a winter growth response driven by plant "reserve" utilisation should be followed by a yield depression (Matthew, et al., 2009). Morgan (1967) argued that due to the phalaris standing more erect after gibberellic acid application, it would then result in more severe defoliation compared to untreated plants. While some farmers may be concerned with a yield suppression in spring, it is not large and often at a time of year, when pasture production is not limiting and not a concern.

To confirm that gibberellic acid does not decrease pasture quality due to its faster growth, feed tests were taken from both the gibberellic acid and urea treated phalaris plots, four weeks after application, to compare the two. The differences are not significant, shown in Table 4.

Table 4. Feed test values for gibberellic acid and urea treated phalaris, four weeks after application.

Analysis	Units	Gibberellic Acid	Urea
Dry Matter	%	25.6	26.7
Moisture	%	74.4	73.3
Crude Protein	% of dry matter	17.1	18.2
Acid Detergent Fibre	% of dry matter	18.2	19.1
Neutral Detergent Fibre	% of dry matter	43.6	44.6
Digestibility (DMD)	% of dry matter	78	75.4
Digestibility (DOMD) (Calculated)	% of dry matter	72.9	70.7
Metabolisable Energy (Calculated)	MJ/kg DM	11.8	11.4
Fat	% of dry matter	5.8	5.8
Ash	% of dry matter	9.1	9.3
Nitrogen	mg/kg of dry matter	27,312	29,184

Table 7. Cost of measured responses to urea and gibberellic acid at four and eight weeks in kilograms of dry matter and cents per megajoule of energy (MJ) and the equivalent grain cost at 100% and 80% utilisation.

Costs of Responses	Urea at 4 Weeks	Urea at 8 Weeks	Gibberellic Acid at 4 Weeks	Gibberellic Acid at 8 Weeks	Equivalent Purchased Grain
Measured Response (kg DM/ha)	29	243	234	120	-
Cost per kg DM	$2.09	25 cents	8 cents	16 cents	44 cents
Equivalent Cost per Tonne of DM	$2090/t	$250/t	$80/t	$160/t	$444/t
Cost at 100% Utilisation (cents/MJ)	19.3 cents	2.3 cents	0.7 cents	1.5 cents	44 cents
Cost at 80% Utilisation (cents/MJ)	24 cents	2.9 cents	0.9 cents	1.8 cents	56 cents

Typical growth responses to gibberellic acid are 350 kg of additional pasture dry matter per hectare at recommended application rates (Saul, 2014). However, a trial across central Victoria found an increase in pasture growth after application by an average of 133 kg DM/ha and suggested that phalaris needed to make up at least 40% of the total pasture composition to make a gibberellic acid application worthwhile (Shea and Campbell, 2019). At Rokewood, it was found that 40 mL/ha of Gala (100 g/L), equivalent to 10 g/ha of Progibb (400 g/kg), caused, on average, an increase in pasture growth of 234 kg DM/ha.

To calculate the economics in the trial, the urea and gibberellic acid cost comparison calculator from EverGraze was used (https://www.evergraze.com.au/library-content/gibberellic-acid/index.html). Results are shown in Table 7.

The assumptions for costs were as follows:

- Urea was valued at $720/t plus $12/ha spread
- Pro Gibb valued at $170 for 400g/kg active product, costing $6.80/ha for product and $12/ha for application
- Purchased grain was $400/t at 90% DM and 13MJ of ME/kg.

The poor response to urea after four weeks, meant it was cost-prohibitive for lifting production at this time, however, the added nitrogen was not wasted and boosted growth in mid-spring. But even when comparing responses of urea at eight weeks and gibberellic acid at four weeks, its cost in production of dry matter and energy is nearly triple.

CONCLUSION

Gibberellic acid and urea have been shown to improve phalaris growth during winter and early spring respectively, and responses were determined by what was limiting production. In 2024, low gibberellin in pastures during winter and low soil nitrogen levels in early spring meant applications at these times resulted in the highest pasture growth. Soil nitrogen levels are constantly changing because of mineralisation, its seasonal influences and plant demands. Therefore, pasture responses to nitrogen in winter should not be assumed. Soil testing can help guide nitrogen fertiliser decisions. Before applying urea or gibberellic acid, make sure that soil fertility is adequate and apply it to the best pastures. Responses can be seen in mediocre quality pastures but expect less growth.

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5.2 • PASTURE & LIVESTOCK • Boosting Phalaris Winter Growth Using Nitrogen & Gibberellic Acid

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