National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

Exemplar for Internal Achievement Standard

Agricultural and Horticultural Science Level 3

This exemplar supports assessment against:

Achievement Standard 91528

Carry out an investigation into an aspect of a New Zealand primary product or its production

An annotated exemplar is an extract of student evidence, with a commentary, to explain key aspects of the standard. It assists teachers to make assessment judgements at the grade boundaries.

New Zealand Qualifications Authority

To support internal assessment

	Grade Boundary: Low Excellence
1.	For Excellence, the student needs to carry out a comprehensive investigation into an aspect of a New Zealand primary product or its production. This involves evaluating the validity of the method and/or reliability of the data and justifying the choices made throughout the investigation, providing a valid conclusion that discusses key agricultural or horticultural concepts and either the findings of others, or scientific principles, theories, or models. The conclusions need to include proposed courses of action, based on the commercial significance of the findings, which the producer may undertake to achieve a specific outcome relating to the primary product or its production. The student investigates the optimum application rate of gibberellic acid for pasture growth. The student evaluates the validity of the method utilised by controlling the variables and eliminating possible errors (1), provides valid conclusions (2) and discusses using the findings from Dairy NZ (3). The student proposes a course of action based on the commercial significance of the findings (4). For a more secure Excellence, the student should include greater discussion on the findings of other sources.

Student 1: Low Excellence

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PRO GIBB FIELD TRIAL

AIM: The aim of my investigation is to find the optimum concentration of Pro Gibb required to maximise plant growth.

HYPOTHISIS: I think the higher the concentration of Pro Gibb the faster the plant growth.
The recommended rate of application for Pro Gibb is 20g/ha.

METHOD:
1) Preparing Stock Solutions – we made up 5L solutions of Pro Gibb for each concentration in a conical flask
Equipment required – 5L conical flask, 200mL beaker, pipette, funnel, measuring cylinder, 5L plastic container for storage, electronic scales
- First we measured the weights of solid Pro Gibb needed: 0.5g, 1g, 1.5g and 2g
- We then added that to distilled water in a 200mL beaker to make a solution we then added that to the 5L conical flask and filled it up to the line with distilled water to get an accurate concentration.
- Once 5L was accurately measured we added 5mL of country mile organ silicon.
- We poured this all into 5 litre containers for holding.
2) Preparing Plots
- We mowed a strip 2m wide by 14m long in a paddock of established grass and separated it into $1m^2$ blocks.
- We used 4 of these blocks for each concentration
- Using electric fence wire and standards we created a grid pattern
3) Application of Pro Gibb
- We took 40mL of each stock and diluted it with 1L of water for ease of application
- We applied the Pro Gibb using a rose sprayer
- The first four squares were left as a control with only water being added, while a 1m gap was left between each concentration to limit spray drift
4) Harvesting
- We cut the grass using an electric hedge trimmer, keeping the same length of grass for each sample
- We gathered up the grass using a leaf rake and put each sample in a labelled plastic bag.

Harvesting grass

5) Weighing and Drying
- We first weighed all samples to get their wet weight using electronic scales
- We then dried 5 samples using a microwave and calculated the % dry matter
- Next we calculated the average and used that to estimate the dry matter for the rest of the samples. (We did this because of the time required to dry all of the samples) also we eliminated outliers when calculating average.

RESULTS

wet weight	sample 1	sample 2	sample 3	sample 4	average
no Pro Gibb	488	319	555	536	474.5
0.001g	630	490	476	481	519.25
0.002g	484	546	578	644	563
0.003g	349	559	383	400	422.75
0.004g	686	527	635	548	599

dry weight	sample 1	sample 2	sample 3	sample 4	average
no Pro Gibb	106	64	~~208~~	104	91.33
0.001g	134	105	102	103	111.00
0.002g	103	116	123	137	119.75
0.003g	83	119	82	85	92.25
0.004g	146	112	135	117	127.50

(Eliminated no Pro Gibb sample 3 because it is an outlier)

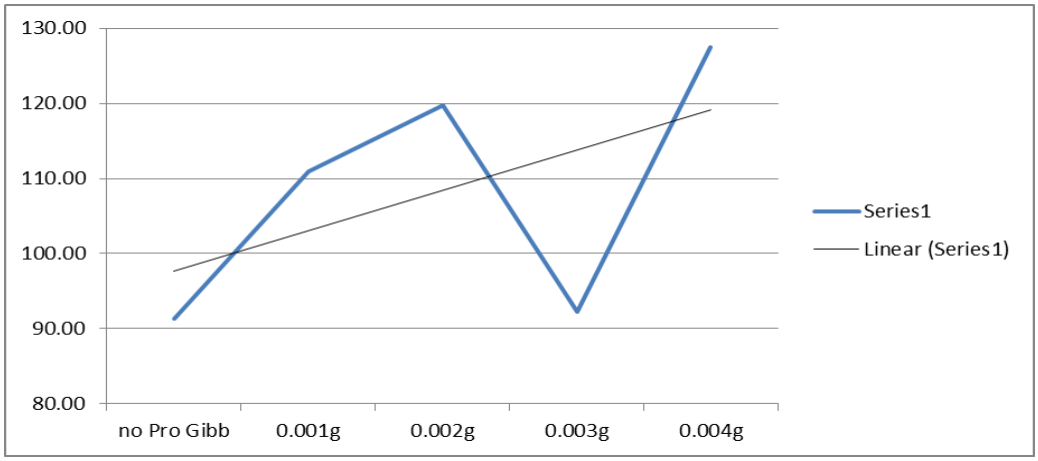
% Dry matter	sample 1	sample 2	sample 3	sample 4
no Pro Gibb	21.7	20.1	37.5	19.4
0.003g	23.8			

Average % Dry matter $= \frac{21.7+20.1+37.5+19.4+23.8}{4}$

→ eliminate out liars

$= \frac{21.7+20.1+\cancel{37.5}+19.4+23.8}{4}$

$= 21.25\%$



My graph shows that the average weight of dry matter is increasing as the rate of Pro Gibb applied rises with the exception of 0.003g which we see a large drop back to just above the control.

Report

I controlled variables and eliminated errors in the preparation of the stock solutions by using accurate chemistry equipment to measure volumes and by using distilled water instead of tap water I prevented any extra contaminants being sprayed on the trial area. By leaving a 1m gap between the samples of different concentrations in my grid I was able to limit spray drift witch would hinder my results, also applying the Pro Gibb on a calm day helped to prevent this. Using a hedge trimmer to cut the grass eliminates human era because if I was to use hedge clippers for example it would most likely result in an uneven cut giving me invalid data. By eliminating outliers in my data it made my calculations more accurate and helped to prevent eras. (1)

From my investigation it is clear that Pro Gibb (40% gibberellic acid) makes a significant difference in the dry matter production of grass. My data basically matched my hypothesis with the exception of the 0.003g/m^2 with the overall trend being as I had anticipated. The best rate of application I found to be 0.004g per metre squared of Pro Gibb. The recommended rate of 0.002g/m^2 is 6.1% less than this while the control is 28.4% less. However it is more economically viable to apply the recommended rate because the extra cost involved in doubling the rate (from 0.002g/m^2 to 0.004g/m^2) only results in a 6.4% increase in total dry matter per m^2 which is ultimately not worth it. I calculated that the average cost per kg of dry matter (extra from the control) for the recommended rate of 0.002g/m^2 to be 4.2c kg. While the rate double the recommended 0.004g/m^2 worked out to be 6.6c kg dry matter. (2)

Therefore the best rate to apply Pro Gibb at to get the best balance between price and quantity is 0.002g/m^2 so farmers wanting to maximise profit should use this rate. Because of this I agree with the recommended rate of 20g per hectare and if farmers want to get the best gains for a reasonable price they should apply Pro Gibb at this rate. (4)

Research that I did on Pro Gibb told me that when Dairy NZ ran a similar trial they found that the average amount of dry matter Pro Gibb produced was around 310kg/ha more than untreated grass, this backs up my trial as I found that the recommended rate of application grew 284kg/ha more than the control. The slight variation from Dairy NZ's results could be due to grass variety and growing conditions. Judging from this I think my data is reliable due to the likeness to the dairy NZ trial results. (3)

	Grade Boundary: High Merit
2.	For Merit, the student needs to carry out an in-depth investigation into an aspect of a New Zealand primary product or its production. This involves developing a method that allows for collection of data that is valid and reliable, and providing valid conclusion(s) that link key agricultural or horticultural concepts to own findings and to those from other source(s). The student investigates the optimum application rate of gibberellic acid for pasture growth. The student develops a method that allows for collection of data that is valid and reliable (1), provides valid conclusions (2) and links them to key agricultural concepts from their own findings (3) and to those from other sources (4). To reach Excellence, the student should specifically state their proposed course of action based on the commercial significance of the findings.

Student 2: High Merit

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Aim: To find out the optimum rate of ProGibb required to increase pasture growth.

Hypothesis: I predict that the lower than recommended rate of progibb will be the best because Nufarm (the progibb marketer) may be trying to encourage farmers to use a heavier rate so that they have to buy more to cover the same area.

Independent Variable: The amount of giberellic acid applied (via stock solutions)

Controlled variables: Time from application to grass collection; same soil type and topography; same pasture; same pasture length at the start; same measuring system and tools eg. Hedge trimmers and scales; same quantity of water applied.

Dependant variable: Pasture DM quantity

Method for stock solution:

1) Get a 5L conicle flask with a cork, a measuring cylinder, a small plastic pipette, surfactant, distilled water, progibb, 5L containers and small watertight containers to hold 4x10mL samples of each solution. (1)
2) Take the conicle flask and pour 2.5litres of distilled water into the conicle flask.
3) Measure out 0.5grams of progibb and place into a beaker then mix with distilled water until completely dissolved.
4) Pour the mixture into the conicle flask.
5) Measure out 10mL of surfactant using a measuring cylinder and pour into conicle flask
6) Rinse out both the beaker and the measuring cylinder into the flask 3 times with distilled water.
7) Fill up conicle flask with distilled water until it is just below the 5L mark then use the small plastic pipette to pipette distilled water into the conicle flask until the bottom of the meniscus is just on the 5L mark.
8) Shake the conicle flask with the cork on to mix the solution up then pour into the 5L container through the funnel stopping and mixing the flask occasionally to ensure that everything comes out.
9) Repeat steps 2 to 8 another 3 times increasing the amount of progibb by o.5grams each time.

Method for cutting and applying progibb:

1) Collect a 1mx1m wood frame (one metre squared), building spray marker, a lawnmower, a garden mister, water, a measuring cup (250mL) and 4x10mL samples of each stock solution (using a 10mL pipette) and labell appropriately.
2) Cut a 12mx10m area of pasture down to an even height in a place with equal shelter, sun, topography and the same grass type in a place where the pasture is even.
3) Use the one metre squared wood frame and mark out 20xone metre squared plots as follows:
4) Using the measuring cup measure out 250mL of water and pour into the mister then apply to the first plot in line 0.
5) Repeat step 4 for all other plots in line 0.
6) Pour one 10mL sample of stock solution 1 into mister then measure 250mL of water into mister and apply to the first plot in line 1.
7) Repeat step 6 for all the other plots in line 1 rinsing out mister after each plot.
8) Pour one 10mL sample of stock solution 2 into mister then measure 250mL of water into mister and apply to the first plot in line 2.
9) Repeat step 8 for all other plots in line 2 rinsing out mister after each plot.
10) Pour one 10mL sample of stock solution 3 into mister then measure 250mL of water into mister and apply to the first plot in line 3.
11) Repeat step 10 for all other plots in line 3 rinsing out mister after each plot.
12) Pour one 10mL sample of stock solution 4 into mister then measure out 250mL of water into mister and apply to the first plot in line 4.
13) Repeat step 12 for all other plots in line 4 rinsing out mister after each plot.
14) Wait 14days and then cut each plot down as low as possible (all the same height) with hedge trimmers.
15) Collect the grass from each plot and weight using kitchen scales then record the weights in a table.
16) Dry the grass from 3 of the plots using a microwave then work out the average percentage drymatter content which will be the predicted drymatter content for the rest of the plots.
    (Dry weight/wet weight) . (100/1)
17) Remove any outliers from the results then calculate the average drymatter content for each different progibb application rate and the control plots.
    Average wet weight . DM%
18) Compare the results from lines 1,2,3 and 4 to line 0 to see which application rate of progibb is the optimum rate, taking into account costs and returns.

Conclusion: From the data found during the experiment I found out by carrying out the experiment that stock solution 4 when applied to pasture gave the best growth response of 20.6%. This was an application rate of 16grams to the hectare of gigerellic acid (40grams to the hectare of progibb). The recommended rate of 8 grams of giberellic acid to the hectare (20grams to the hectare of progibb) gave a response of 3.8% over the 14days which is less than half that of 40grams to the hectare of progibb. This means that the optimum rate of giberellic acid is 16grams to the hectare (40grams to the hectare of progibb). Applications 1 and 3 gave responses but these weren't as strong as those seen from application 4. The results show that my conclusion was wrong and as the amount of progibb applied increased the pasture response increased aswell. 2

Discussion: Progibb (40% giberellic acid) is a growth regulator used to stop pasture going dormant and to increase pasture growth when temperatures are lower than optimum. Progibb can be purchased from rural supply stores such as CRT at a cost of around $180 for 250grams. At the optimum rate this would be enough to cover 6.25Ha.

The cost of application and chemical for this optimum rate would be around $130/Ha. Through a boom sprayer and could return a dairy farmer roughly $370 over a 2 week period. This is based on an average cow eating 17kgDM/day and turning it into 1.47kgMS/day. The returns over application cost is almost 4 so it is well intruely worth the application especially on the shoulders of the milking season where conditions aren't favourable and the farmer has time. 3

The following graph shows the cost against the return of application over a 14day period which shows that application 3 and 4 were the only ones worth doing because they returned a production increase of more than the application rate. Application 1 and 2 had higher costs than returns so would not be worth carrying out.

Evaluation: I believe my results are reliable because the controlled variables were all kept the same during the experiment. Once the results were gathered I removed outliers because these effected the overall results of the experiment. This meant that the final results were far more accurate because before the outliers were removed the recommended rate showed a lower growth than when nothing was applied which I believed was not correct. Results from a trial carried out at Massey University in 2008 by W. Hofmann show that the application of progibb could increase pasture growth by 195kgDM/Ha. Over 4 weeks. The application rate was not stated but comparing these to the results I found they are reasonably similar if the extra growth rate on my trial plots continued to be similar for a future 2 weeks. The testing was to do with dairying so the pasture used was Harper long rotation ryegrass that was 3years old and treated with AR1 endophyte as seed. White clover, red clover and chicory were also apart of the mix but not significantly. This grass would be a similar grass type used on a dairy farm so it would resemble the characteristics of grass used on a dairy farm. 4

	Grade Boundary: Low Merit
3.	For Merit, the student needs to carry out an in-depth investigation into an aspect of a New Zealand primary product or its production. This involves developing a method that allows for collection of data that is valid and reliable, and providing valid conclusion(s) that link key agricultural or horticultural concepts to own findings and to those from other source(s). The student is investigating the optimum application rate of gibberellic acid for pasture growth. The student produces a method that is valid and reliable (1), provides a valid conclusion (2) and links key agricultural concepts on dry matter (3) with a brief link from the key agricultural concepts to their own findings and those of another source (4). For a more secure Merit, the student should provide more detailed explanations of the key agricultural concepts and relate them to other sources.

Student 3: Low Merit

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Pro Gibb

***Aim*:** The aim of this investigation is to determine the optimum application rate of the gibberellic acid for optimum pasture growth and measure what plot has the most percentage change and highest dry matter.

Hypothesis: I think the rate of 0.003g will produce the most dry matter and grass and then next will be the rate of 0.002g that is the recommended rate for the pro gibb. Then the two rates that I think will not perform well will be the rate 0.001g because it does not have much pro gibb and the rate of 0.004g will be too strong and will stunt the growth of pasture for some time. Then behind all of them is the controlled rate of 0.000g.

Method: To start I chose an area that got the same sun light and rain and the soil type was all the same and there was no organic matter left that would affect this test. I then mowed five plots of 1×4m and marked them out so they were all 1×1m sections so that I would get a fair test and a good result. To make sure no stock got near I fenced that area off. I did this on the 27/8/12. 1

Stock solution : We had to make a stock solution because we were not able to get the scales to read the very small amount of pro gibb.

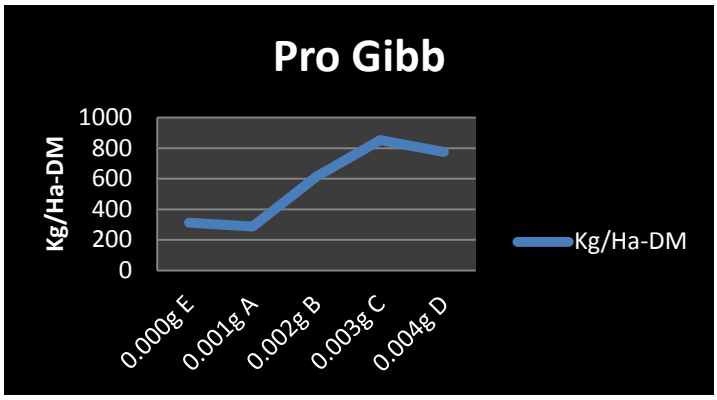
1) 5L of water to 0.5g of pro gibb and then 5ml of country mile organ silicon.
2) 5L of water to 1.0g of pro gibb and then 5ml of country mile organ silicon.
3) 5L of water to 1.5g of pro gibb and then 5ml of country mile organ silicon.
4) 5L of water to 2.0g of pro gibb and then 5ml of country mile organ silicon.

When all of these stock solutions were made I took 40ml of each rate and kept all of the rates in different jars. Then once home I added 250mL of water to 10ml of our solution and applied it onto the 1×1m section with a fine mist rose sprayer that had a boom 1m wide and repeated this 3 more times to make up the area of 1×4 plot and then repeated this 3 times for the other plots. I cleaned out the sprayer each time when I used a different rate of application. For plot 5 I just applied 250mL of water to the 4 x 1×1m sections to make sure it was all a fair and even test, this was all done on the 3/9/12.

I collected the data on the 16/9/12 using the push mower. I cleaned it out so there was no left over grass that could change my results and then mowed a 1×1m section. I then put the clippings onto Mum's baking scales and measured the "wet weight" of the grass and recorded my results. I then put the grass into a plastic bag named with the section where the grass came from and repeated this 20 times to gather all the information from my trial.

I took the grass into school on the 17/9/12 and opened the bags and put one bag at a time on to a plate and put it into the microwave. I cooked the grass for one minute at a time and then turned the grass over after each minute and kept doing this till the grass was dry and crisp. I then weighed the grass to get the dry matter on baking scales measured in grams and then recorded the results and repeated this each time for each bag to get my results and recorded the data in my field work book.

Results:		**1**	**2**	**3**	**4**	**Average**
Plot 1 (a) *0.001g Pro Gibb Rate*	**Wet Weight**	75g	95g	80g	95g	**87g**
	Dry Weight	25g	25g	35g	30g	**28.75g**
	Kg/Ha-DM					***287.5***
Plot 2 (b) *0.002g Pro Gibb Rate*	**Wet Weight**	150g	145g	125g	135g	**138.75g**
	Dry Weight	61g	63g	54g	68g	**61.5g**
	Kg/Ha-DM					***615***
Plot 3 (c) *0.003g Pro Gibb Rate*	**Wet Weight**	180g	230g	220g	175g	**201.25g**
	Dry Weight	81g	87g	90g	83g	**85.25g**
	Kg/Ha-DM					***852.5***
Plot 4 (d) *0.004g Pro Gibb Rate*	**Wet Weight**	170g	140g	145g	160g	**153.75g**
	Dry Weight	80g	73g	76g	81g	**77.5g**
	Kg/Ha-DM					***775***
Plot 5 (e) *0.000g Pro Gibb Rate*	**Wet Weight**	70g	50g	85g	75g	**70g**
	Dry Weight	30g	29g	34g	32g	**31.25g**
	Kg/Ha-DM					***312.5***



Conclusion: In my investigation I had to determine the optimum rate of application for the gibberellic acid. To do this I did a trial on some old rye grass with the different rates of pro gibb that where 0.000g, 0.001g, 0.002g, 0.003g, 0.004g. These were the rates of pro gibb and the controlled rate was 0.000g that was made up of no pro gibb just water. Once I finished the trial and the data was recorded I found that the rate of 0.003g of pro gibb produced the most grass. That was the wet weight and then its average dry matter was 853.5kg/Ha-DM. (3)

This rate produced the most grass by far out of all the other rates and this made it the optimum rate of pro gibb. (2)

Discussion: *Independent trials conducted at Massey University by Wayne Hofmann showed an increase of 200kg/ha DM from the Pro Gibb SG application over a 28-day period from 1-29th September 2008.*

Percentage response rate can vary hugely depending on the amount of grass growing at the time, but Hofmann says his data shows the gain in 200kg DM/ha after Pro Gibb application could be lost the following month when grass growth could be depressed by a similar amount. (http://www.country-wide.co.nz/article/10424.html)

The trials done by Wayne Hofmann on pro gibb, show his results are very similar to my results in the trials that I did. The grass that had Pro Gibb did grow more than the controlled with no pro gibb. The plots with Pro Gibb did produce more dry matter per hectare but I can see what Wayne Hofmann was saying that the grass could grow more at this time. But then after a few grazing's the grass might not produce as much dry matter because it has used up a lot of its food reserves and energy because pro gibb was applied to make the grass grow more and produce more dry matter. We did not cut the grass again after we cut it the first time so I do not have any data to back this theory but it does make sense through biological terms. (4)

	Grade Boundary: High Achieved
4.	For Achieved, the student needs to carry out an investigation into an aspect of a New Zealand primary product or its production. This involves producing a statement of purpose, planning the method to be used, collecting, recording and processing primary data, interpreting findings based on own processed data, reporting findings and relating them to findings from another source relating to the agricultural or horticultural context, and proving a valid conclusion(s) that relates to the purpose of the investigation. The student is investigating the optimum application rate of gibberellic acid for pasture growth. The student produces detailed evidence, including figures and graphs, of carrying out of an investigation. They produce a statement of purpose (1), plan the method (2), collect, record and process primary data (3), interpret and report their findings (4), and relate them to findings from another source (5). A valid conclusion is provided that relates to the purpose (6). To reach Merit, the student should explain in detail how the method is valid and reliable and the conclusions should be better linked to key agricultural concepts.

Student 4: High Achieved

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1

Pro-Gibb – Gibberellic Acid.

Aim: To find out the optimum application rate of gibberellic acid for pasture growth.

Preparation and spraying on Pro-Gibb

Equipment: Lawn mower, an even section of perennial rye grass, At least 80 metres of string, 45 pegs or standards,

#1- with a lawn mower, mow an even section of perennial rye grass 14 meters by 2m. Collect the cut grass in the catcher; leave grass at 3cm above the soil. The mowing process represents grazing.

#2- we are trialing five concentrations, each concentration will be trialed in a metre squared plot four times, so for each concentration we will need 4 metres squared, Mark plots out using pegs and string, the measurement should be within the nearest cm. Have one metre gaps between each 4m squared plot so spray drift will be less likely to occur.

2

#3- with a 10mL pipette measure out 10mL of the 0.001 Grams per Litre concentration and mix it into a nap sack rose sprayer with 2L of water. Make shore the sprayer and mixing items are washed out thoroughly (3-4 times) with distilled water to avoid any contaminants. Spray the mixture on one square metre of the section ensuring that the spray is evenly applied; remember not to allow spray drift. Do this procedure four times for each concentration. Label each 4m-squared plot via the concentration of Pro-Gibb applied.

Final method - Mixing:

You will need four 5-litre drums, a funnel, 30 litres of distilled water, a funnel, conical flask, 5-grams of Pro-Gibb, 20 mL of Country mile organic silicon, safety glasses, Scales that can measure no less than two significant figures.

#1- you will need to measure out four stock solutions for each concentration because the size of the Pro-Gibb will be to hard to accurately weigh in smaller form.

#2- Fill a clean 5-litre conical flask up with distilled water, add Pro Gibb and 5mLs of Country mile organ silicon. Pour the mixture into a container and label by its concentration. Do this process for all four mixtures.

Mixture A- 5L water, 0.5g Pro Gibb, and 5mLs of Country mile organic silicone.

Mixture B- 5L water, 1.0g Pro Gibb, and 5mLs of Country mile organic silicone.

Mixture C- 5L water, 1.5g Pro Gibb, and 5mLs of Country mile organic silicone.

Mixture D- 5L water, 2.0g Pro Gibb, and 5mLs of Country mile organic silicone.

#3- we only want 40mLs of each solution, with a measuring cylinder measure out 40mLs of each mixture, pour into clean separate containers. Now the solutions are ready to be used.

Harvesting the grass to find out the percentage change in dry matter:

#1- Fifteen days after Pro-Gibb application collect 20 supermarket bags, cut each plot (metre square) with clippers right down to soil level. Put grass-avoiding contaminants such as dirt; from each plot into separate bags remember to label these bags of what the sample they contain.

#2- Weigh each bag of grass and record it as wet weight on the table below.

#3- put one bag of grass in a casserole dish, place in a microwave, and turn it on high until all the moisture has evaporated from the grass. Re-weigh the grass; this is how we find out the dry matter. Do this process for all 20 samples and record on the table that says Dry matter below. When calculating the average grams of dry matter per metre squared make shore to leave out any outliers, these will have an effect on the results.

#4- We found out that drying out the grass to find the dry matter using a microwave took to long, we found it easier to weigh all the wet weights and find the predicted dry matter content in the grass. This meant that we only had to find the dry weight three samples.

$$\text{Average \% dry matter} = \frac{\text{sample\#1 + sample\#2 + sample \#3 + sample \#4 (DM plot A)}}{4}$$

We took this as the average % dry matter making shore to leave out any outliers.

Once you find the average % dry matter divide it into every wet weight sample.

Wet weights (grams per meter^2)

Concentrations	Sample#1	Sample#2	Sample#3	Sample#4	Average
0.000	488	319	555	536	474.5
0.001 (a)	630	490	476	481	519.2
0.002 (b)	484	546	578	644	563
0.003 (c)	349	559	383	400	422.75
0.004 (d)	686	527	635	548	599

Concentrations	Sample#1	Sample#2	Sample#3	Sample#4	Average
0.000	106	64	208	104	91.3
0.001 (a)	134	104.6	101.6	102.6	102.9
0.002 (b)	103.3	116.5	123.3	137.4	120.1
0.003 (c)	83	119.3	81.73	85.4	92.35
0.004 (d)	146.4	112.5	135.5	116.9	127.8

3

Concentrations	Average KgDM per Ha
0.000	913
0.001 (a)	1029
0.002 (b)	1202
0.003 (c)	923
0.004 (d)	1278

Dry weight (grams per meter^2)

Dry weight (Kilograms per hectare)

Calculating kgDM per ha

Formula = $\frac{\text{average weight DM g/m}^2}{1{,}000 \times 10{,}000}$

0.000g = $\frac{91.3\text{g/m}^2 \times 10{,}000}{1{,}000}$ = 913 kg/ha

0.001g = $\frac{102.9\text{g/m}^2 \times 10{,}000}{1{,}000}$ = 1029 kg/ha

0.002g = $\frac{120.25\text{g/m}^2 \times 10{,}000}{1{,}000}$ = 1202 kg/ha

0.003g = $\frac{92.35\text{g/m}^2 \times 10{,}000}{1{,}000}$ = 923 kg/ha

0.004g = $\frac{127.8\text{g/m}^2 \times 10{,}000}{1{,}000}$ = 1278 kg/ha

Valid conclusions

Our results suggest that adding double the amount of required Pro-Gibb will increase dry matter production by 6.4%. Ideally if we double the solution the farmer would like a 100% increase in dry matter production but realistically is only getting a 6.4% increase. This is where our results back up the nationally required amount of Pro-Gibb concentration which is 0.002 grams per litre of water, making it twice as concentrated (0.004 grams) will mean that it will cost twice as much and the farmer will only get a 6.4% increase in production. 4

Our results also suggest that adding the Pro Gibb at the recommended rate will mean there will be a 12% increase in dry matter production compared to applying no Pro Gibb. 6

Supporting evidence:

Nufarm LTD has carried out a number of replicated field trials. The script reads "where Pro Gibb was applied according to label directions the average response from Pro Gibb was an extra 310 Kg DM/ha over untreated controls. Pasture responses are reliable if label directions are met". This backs up our results as its supports using the advised application rate; our average response from Pro Gibb was an extra 284.2 Kg DM/ha over untreated controls. Using the required concentration is essential for optimum production. 5

	Grade Boundary: Low Achieved
5.	For Achieved, the student needs to carry out an investigation into an aspect of a New Zealand primary product or its production. This involves producing a statement of purpose, planning the method to be used, collecting, recording and processing primary data, interpreting findings based on own processed data, reporting findings and relating them to findings from another source relating to the agricultural or horticultural context, and proving valid conclusion(s) that relates to the purpose of the investigation. The student is investigating the optimum application rate of gibberellic acid for pasture growth. The student provides sufficient detail to carry out the investigation into the effect gibberellic acid has on pasture. The method is aided through the use of appropriate photos. They produce a statement of purpose (1), plan the method (2), collect, record and process primary data (3), interpret and report their findings and relate them to findings from another source (4). A valid conclusion is provided that relates to the purpose (5). For a more secure Achieved, the student should provide more detail in the conclusion and relate their findings in more depth to another source.

Student 5: Low Achieved

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1

Aim - To carry out an investigation to determine the optimum rate of gibberellic acid for pasture growth.

Hypothesis - I think the recommended rate which is 0.002g will grow the same height as the 0.004g but want grow the same bulk. The lowest one (0.001g) will grow the same as the one with no Pro Gibb on it. The one with the most Pro Gibb (0.004g) will grow the most bulk and the fastest.

Controlled Variables - The plots are all going to be the same size 1m squared. They are going to be all in the same environment. They are all in the same grass paddock on top of a hill in the open.

Independent variable - The independent variable is the different amounts of Pro Gibb we are applying to the plots. The same amount will go on the 4m squared plots but every 1m squared will be sprayed separately.

Dependant variable - We are going to measure the ratio of dry matter of the grass to the amount of Pro Gibb we sprayed on the grass.

Pro Gibb Rates

0.001 g/L	0.002 g/L	0.003 g/L	0.004 g/L
X4	X4	X4	X4

There will be one plot with no Pro Gibb sprayed on in. That will be the controlled plot.

1 mete

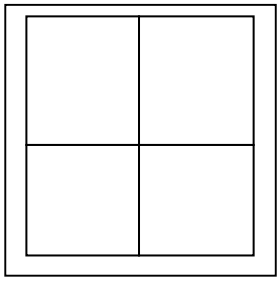
Advised rate on the bottle.

Recommendations from Bottle.

Apply 1-5 days after grazing
Growth stimulation should be seen after 7 days.

Change rate mixing: We had to change the way we mix the Pro Gibb. We were going to weigh the Pro Gibb out in the rates like above. We had to change it because the scales wouldn't go lower than 0.005g and they only went up in 0.005g

We ended up doing a stock solution which we turned the Pro Gibb pallets into a liquid. We still use the same amount of Pro Gibb to the same area of grass. We made it into a 5L mix in a conical flask. We mix are mixing this at school with the equipment we needed to use.



Plot Design I am going to have 5 plots like this. The plots will have a meter in between the 4 meter squared plots as this diagram shows. There will be 4 different trials for each rate to get a fair test. The 4M^2 plots will be split in 4 squared 1M^2.

Method:

Step 1: I am going to mow the amount of area I need for my trial. I will mow it on 3 all over. I will collect the grass when I mow it so there is no dead grass on pots. This trial is going to be on flat ground. My trial is in one of the paddocks which are sugar grass and clover. By using the same paddock it will be a fair test because there will be the same environment, it would have the same nitrate levels, moisture and soil structure.

Step 2: I am going to mark out the plots with standards after I have mown it. I will use tape for the lines so I know were my plots are. I will put standards in the center of the box so I can tie the tape to.

2

Step 3: After I have marked the first one out I will leave a 1m gap between them for spray drift. I will do that for every one of my 5 plots. The first plot want get sprayed with Pro Gibb.

Step 4: When I have marked them all out I am going to mix my first trial plot Pro Gibb up (0.001g).

Step 5: I am going to use a nap sack to spray the Pro Gibb on. Mix 10mls of Pro Gibb with 2L of water; give it a shake up to mix it good.

Step 6: I am going to spray on trial plot (1m2). Keep spraying in tell the nap sack runs out.

Step 7: Repeat the same to all 4 of the 1m^2 plots.

Step 8: I am going to keep spraying the rest of plots with the different rates (0.002, 0.003, and 0.004).

Step 9: After I have sprayed all the 4 plots I am going to leave it for 20 days to grow. I am not going to water it unless it rains.

Step 10: After 20 days I will cut the grass using hedge trimmers and then I will up all the grass from the plots. Each 1m^2 will go in a separate bag.

Step 11: After I have collected the grass up I am going to bring back in to the lab at school.

Step 12: We will weigh it on the scales in the bag. We will weigh all the bags and record the results table.

Step 13: Then in microwave heat till the grass is dry. Weigh the dry grass and record results.

The way we got Pro Gibb and had to change it: We were going to weigh out the Pro Gibb. We got it as a solid particle. The scales only go down to 0.005g and they only go up in 0.005g we needed to weigh 0.001g. We had to make it in to a liquid form. We made it in to 5L lots so we had to weigh more Pro Gibb. The amount of Pro Gibb went up in 0.005g and started at 0.5g and the most was 2g.
The way we mixed it: We pored 5L if distilled water in to a conical flask. We filled the flask half fall then put the Pro Gibb in with the pre mix with a bit of distilled water. After we put the Pro Gibb in we fill the flask up to the 5L line. When we got the distilled water to the 5L line we added 10mls of penetrate liquored.
The way we made stock solution:

1. 5L distilled water, 0.5g Pro Gibb, 5mls of country mile organic solution
2. 5L distilled water, 1g Pro Gibb, 5mls of country mile organic solution
3. 5L distilled water, 1.5g Pro Gibb, 5mls of country mile organic solution
4. 5L distilled water, 2g Pro Gibb, 5mls of country mile organic solution

Table for results:

Plot 1	Trail 1	Trail 2	Trail 3	Trail 4	Add up weights	Average weights
Wet weight	488g	319g	555g	536g	1418g	474.5g
Dry weight	106g	64g	208g	104g	482g	120.5g
% DM weight	21.7%	20.1%	37.5%	19.4%	33.9%	25.3%
kgDM/ha						105
Plot 2 0.001 Pro gibb						
Wet weight	630g	490g	476g	481g	2077g	519.2g
Predicted dry weight	134.4g	104.6g	101.6g	102.6g	443.2g	102.6g
kgDM/ha						1108
Plot 3 0.002 pro gibb						
Wet weight	484g	546g	578g	644g	2252g	563g
Predicted dry weight	103.3g	116.5g	123.3g	137.4g	480.5g	120.1g
kgDM/ha						1201
Plot 4 0.003 pro gibb						
Wet weight	349g	559g	383g	400g	1691g	442.7g
Predicted dry weight	83g	119.3g	81.77g	85.4g	369.4g	92.3g
kgDM/ha						923
Plot 5 0.004 pro gibb						
Wet weight	686g	527g	635g	548g	2396g	599g
Predicted dry weight	146.4g	112.5g	135.5	116.9g	511.3g	127.8g
kgDM/ha						1278

3

The way we worked out %DM: We decided to dry there 4 bags of grass and get an average DM %. We are going to use the average DM and the wet weight of each sample to calculate the predicted DM of each sample.
Calculations: Wet weight times Average DM%= Dry weight (prediction DM)
Working average DM: Trial 1+trial 2+trial 3+trial 4= Average DM
The way worked out KgDM/ha: Dry weight *10000/1000= kgDM/ha
Conclusion My hypothesis was right because the plot with the most pro Gibb on grew the fastest. My observation was that the recommend rate and the most rates grew the same high but not the same bulk.

5

Discussion We carried out the investigation to find out if putting more Pro Gibb on will affect the growth of the grass. We did 4 different rates of Pro Gibb and made the recommended rate in the middle. We put too rates below it and too above it. I found putting more Pro Gibb on the grass per/m2 made it grow the most and most bulkiness. Plot 5 (0.004) grew the most, it had the most kgDM/ha. The one with the recommended rate (plot 3, 0.002) wasn't far behind pot 5.It grew faster grass but not the same bulkiness as the plot with 0.004 Pro Gibb on.

4

From my finding and other findings I found is to stick to the recommended rate of Pro Gibb and if you wanted to spread urea on with the Pro Gibb. It gives it a higher kgDM/ha by putting both on. The response from Pro Gibb was within the range expected from the Nufarm trials. I found out that the Pasture doesn't respond till after 3, 4 weeks of Pro Gibb being on the pasure. They found out that the yield was similar to or less than the response at 3, 4 weeks.

References: Dairy NZ farm facts sheets, The bottle of pro Gibb, Fact sheet from Pro Gibb

	Grade Boundary: High Not Achieved
6.	For Achieved, the student needs to carry out an investigation into an aspect of a New Zealand primary product or its production. This involves producing a statement of purpose, planning the method to be used, collecting, recording and processing primary data, interpreting findings based on own processed data, reporting findings and relating them to findings from another source relating to the agricultural or horticultural context, and proving a valid conclusion(s) that relates to the purpose of the investigation. The student is investigating the optimum application rate of gibberellic acid for pasture growth. The student produces a statement of purpose (1), plans the method to be utilised (2), collects, records, processes and interprets their primary data (3), reports on the findings and provides valid conclusions that relate to their purpose of the investigation (4). The student attempts to relate the findings from another source back to their own findings (5). To reach Achieved, the student should relate their findings to the findings from another source.

Student 6: High Not Achieved

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Faster growing pasture in dairying.

Aim: To find out the optimum growth rate of gibboralic acid when applied to pasture at different quantities over a period of 3-4 weeks. (1)

Hypothesis: I believe that sample 4 0.004L of gibboralic acid will growth the most and produce the heaviest amount of dry matter. I only think his because this sample has the largest amount of gibboralic acid to same amount of water as the other 3 test samples.

This may change though on the weather or the amount of sunlight each sample will get. One sample may be in a shady spot of the paddock. Or there might be a slight change in soil type. E.g one patch might have a different measurement of nitrogen in the soil which will increase the growth rate hugely. I have to be careful choosing a spot in the paddock. I have to be careful of stock as well as they might come into my paddock which will ruin my tests if they happen to eat any grass.

Dependant variable: This is the one that I am going to measure. I am going to measure the weight of dry matter that is in the pasture. Starting with the control. Then doing each other gibboralic sample one after the other. When I have measured each amount of dry matter I will compare it to the controlled test as this one has no amount of gibboralic acid what so ever. To test the dry matter I will cut each sample after 3-4 weeks with the lawn mower. I will catch and collect the cut grass bag it then bring it to school where I will do all my weighing. Firstly to get dry matter I will have to put it either in the microwave or oven to evaporate the water out of it then I will be left with the dry matter which can then be weighed and compared.

Independent variable: The things that I will keep the same. I am going to keep the same location with my test so it is the same soil and grass type throughout my whole test. I will also keep the same volume of water as this may or may not effect the rate that the grass grows. By keeping the amount of water the same it allows this to be an even fair test. The grass length when applying the gibboralic acid will be keeped the same also. I will keep the same area that I am going to sample. It will be 20 patches that are 1.7m x 0.6m.

Controlled variable: This will be the thing that I change. I will change the application rate of the gibboralic acid increasing the rate by 0.1 each time.
4 will be a controlled test.
4 will be 0.001L of gibboralic acid.
4 will be 0.002L of gibboralic acid.
4 will be 0.003L of gibboralic acid.
4 will be 0.004L of gibboralic acid.

Control: Will be 0g of gibboralic acid which it won't be applied to one sample of 4.
Recommendation: This is the recommended rate that is suggested to be applied to a $1m^2$ patch of grass. This is the closes area I can get to mine of 1.7m x 0.6m. Each sample will have a range of 4 so every sample will have a fair chance at growing. Each sample will have the same growth period of 3-4 weeks.

Method: I am going to have 20 different strips of grass that will be 1.7m x 0.6m in total (approximately the mower width). The grass will be cut all the same lengths so it will be a fair test. My range will be 4 ranging from 0.001L to 0.004L. Each sample will have 4 different patches that will have the same rate. (2)

When I cut the grass I will weigh the dry matter so i can calculate the increase of dry matter that has come from applying the gibboralic acid.

After 3-4 weeks I will cut each sample of grass and measure the dry matter which is produced. I will compare it to my controlled patches that I am going to have.

I will apply my gibboralic 1-5days after cutting my grass. Growth stimulation should be seen after 7 days and cease after 3-4 weeks.

Stock solution:
A) 5L water : 0.5g of progib (gibberellic acid) : 5mls of country mile organ silicone.

B) 5L water : 1g of progib (gibberellic acid) : 5mls of country mile organ silicone.

C) 5L water : 1.5g of progib (gibberellic acid) : 5mls of country mile organ silicone.

D) 5L water : 2g of progib (gibberellic acid) : 5mls of country mile organ silicone.

Pasture Preparation: When we finished our solutions I went home to prepare my plots for the test to do this I used the lawn mower, the width of the lawn mower blade was ideal. I worked out that the mower blade width would be what the width of my plots would be. This way it would be much easier for me to cut each section easierly. It also works out easier when I want to cut it as I just have to go over the same ground once to get my results. I got home I measure out the length I wanted then rode the mower over it. My length 6.8m which I then divided up into 4 1.7m sections. I had to do this 4 times as I need 4 different results to make it a fair test and to test the optimum growth of a different solution. When I finished doing that I had to collect the cut grass and weigh the dry matter so when it comes to weighing the dry matter when we finish the test we can not only compare it to each different sample but to the original weight of the grass. I started out measuring my plots and cutting the grass for the first initial cut before I would apply progib. I did this a week before tournament week so I was away for a whole week so i did not actually manage to apply my progib, so I got the results from another group which did it similar to me.

Results:

Wet weights:

	1	2	3	4	Average
0	122g	103g	154g	124g	503/4 = 125.75g
1	117g	91g	144g	223g	575 / 4 = 143.75g
2	98g	141g	110g	133g	482 / 4 = 120.5g
3	200g	117g	82g	229g	628 / 4 = 157g
4	172g	99g	111g	137g	519 / 4 = 129.75g

3

0,4 = 36g dry (0,3) + (0,1) = 66g dry

Average dry matter percentage (36+66) / (122+154+124) x 100/1 = 25.5% DM

Conclusion: We found out form the data I help collect that Solution 3 was the best productive wise as it produced more dry matter than any other solution. Solution 2 was the recommended rate of application for progibb. When comparing this to the control (no gibberalic acid) we found that the recommended rate of 1g to 5L of water was below the actual normal growth percentage. So it works out to be poorer. Also stock solution 4 had 3 times the amount of giberalic acid as stock solution 1 and it produced poorer. Producing a little over average than the control pasture.

4

Our best productivity was 200g wet weight of pasture. This is 78% better production than was the control method from the same column is. Solution 3 (5L water : 1.5g of progib (gibberellic acid) : 5mls of country mile organ silicone) was 24% better than the control. This was the biggest percent change. Solution 2 (5L water : 1g of progib (gibberellic acid) : 5mls of country mile organ silicone) was a 5% decrease and this was the recommended rate for the original application.

Discussion: Our results we found were interesting as we did not think that our results would prove that the infact recommended rate was poorer than the control where there was no giberalic acid applied. We thought that our results would prove that the more giberaliic acid would produce more growth. So we all thought that solution 4 would produce the highest amount of growth. Where is fact solution 3 was the highest producer and the recommended rate of 1g of progib produced the poorest. These results could be different because of different soil types etc but all samples were done with in 1 metre radius of each other so should not be different. All solutions are the same with the same amount of water and the same amount of Country Mile Organ Silicone. The only change is half a gram of progib which increased for each solution. We were all amazed in the outcome of our results as they were not what we were expecting. Massey University ran a trial on Progibb. Their results showed that there is an increase of pasture growth but it does not tell us how much progib was applied to this pasture. It was an increase DM/ha weight of +195kg, which sounds like a significant amount of growth. It shows that urea alone produces a higher growth than progib. I suspect they are the same amount applied for both. And progib plus urea provides an even bigger increase of growth. This is a trail for a suggestions for farmers if they want an optimum growth rate.

5