GrassMaster Pro

Drymatter Instrument

User Guide

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Novel Ways
ELECTRONIC PRODUCT DEVELOPMENT

Contents

1.   Introduction

Congratulations on your purchase of the GrassMaster Pro, and thank you for choosing our product.

The GrassMaster Pro is the very best capacitance probe pasture measurement device of its type available anywhere.

This precision instrument is unequalled in terms of quality, flexibility, efficiency and ease of use. It enables farmers and researchers alike to make the very most out of non-destructive pasture measurement. The GrassMaster Pro builds on, and continues, a rich history of GrassMaster research and development in pasture measurement technology. This unit is guaranteed to give you many years of good results, backed up by our ongoing service and support.

What is Dry Matter?

Dry matter (DM) is the portion of the feed remaining after all the moisture has been removed. Its contents include plant structure and materials and their constituent sugars, proteins, vitamins and minerals, from which grazing animals derive their nutrition. Wet weight can be used to describe the same feedstuff with its moisture still present.
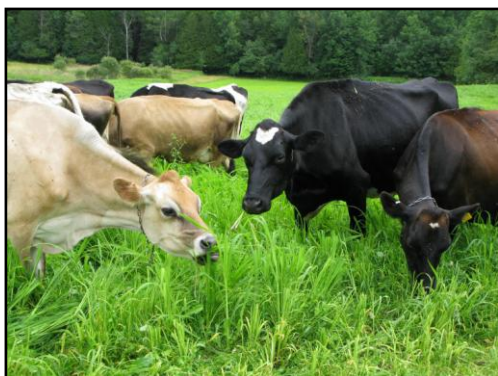
DM is a useful unit because it can be used to describe both the quantity and nutritional value of feed.

This applies to both the production of feed -
e.g. how much pasture there is, in units of kg DM/ha,
and the consumption of feed -
e.g. how many kg DM of feed is required to meet the nutritional requirements of a grazing animal?

Since the water content of feeds can vary so much (pasture is about 80% water and 20% DM while hay is around 20 % water and 80 % DM), expressing all feed types in terms of DM becomes a convenient means of standardising quantities between feed types.

While the nutritional values of feed vary between different feed types, the differences are usually small compared to their differences in water content. This allows us to quantify both the amount and the feed value of different feedstuffs on a kgDM basis alone, which simplifies measurement calculations while giving reasonable accuracy. Accommodating the nutritional differences can be as simple as increasing the amount of DM required of one feed type to equate to the nutritional equivalents of another.
e.g. every 11 kg DM of hay equates to 10 kg DM of pasture.

Energy is the fundamental quantity of the nutritional value of feed. For grazing animals, it is expressed in terms of megajoules (MJ) of metabolisable energy (ME) or MJME. Feeds are quantified in terms of megajoules of metabolisable energy per kg of dry matter or MJME /kgDM. Pasture, for example, typically has 11MJ ME/kgDM, while hay has 10MJ ME/kg DM. Likewise, a milking dairy cow might require 80 MJME per day to meet her maintenance requirements, and a further 110 MJME to meet her milk production needs.

Again, it is convenient (and for most purposes accurate enough) to express these requirements simply in terms of kgDM, since the ME values of pasture and hay are fairly similar, and the ME requirements of cows are fairly standard across animals of similar body weight. For example, if we concerned ourselves with thinking in terms of only kgDM, the same cow would require 7 kgDM of pasture to meet her maintenance requirements, plus a further 11 kgDM of pasture to meet her milk production needs. This greatly simplifies the calculations, and we are dealing in units we can readily relate to in day-to-day life. We can always refer back to ME values when we want to fine-tune things and adjust with kgDM equivalents. The ME values for feed and animal production requirements are well researched, documented and readily available. Perhaps one day, ME might even become the standard for feed-budgeting.

For grazing animal production systems, pasture grazed *in situ* is arguably the most cost-effective feed input. It has also been demonstrated numerous times that profit is usually maximised when animal fee d demand can be met by pasture supply, particularly if this can be achieved on a grass-only production system i.e. no feed supplements bought in, or made. Given that we are able to both predict and measure pasture supply in terms of kgDM/ha/day pasture growth and kgDM/ha pasture amount, and also quantify feed demand in terms of kgDM/animal/day intake, it is apparent that DM provides a simple yet powerful means of describing this relationship. We can therefore use DM measurements for pasture feed-budgeting purposes, where we match feed supply to feed demand. This is a powerful management tool. This, in essence, is why DM is important.

Having a tool like the GrassMaster Pro that can quickly, consistently, accurately and easily estimate DM is likewise important. This is also why the GrassMaster Pro is potentially your most valuable farm management tool.

How does the GrassMaster Pro work?

The capacitance measurement system

The capacitance probe method of pasture measurement works by measuring changes in external capacitance using a circuit inside the probe. The more grass there is near the probe, the more the capacitance is influenced. The indicator processes this data and converts it into kilograms per hectare of dry matter.

The GrassMaster Pro has several built-in features to compensate for, and minimise the effects of, different pasture characteristics like internal pasture moisture (dry matter content), external pasture moisture (dew, rain), pasture morphology (leaves or stalks), ambient temperature and relative humidity, and even ground soil moisture. The GM Pro generates the CMR (Corrected Meter Reading) and uses it in a simple linear equation. The CMR value can also be used in a multiple regression equation.
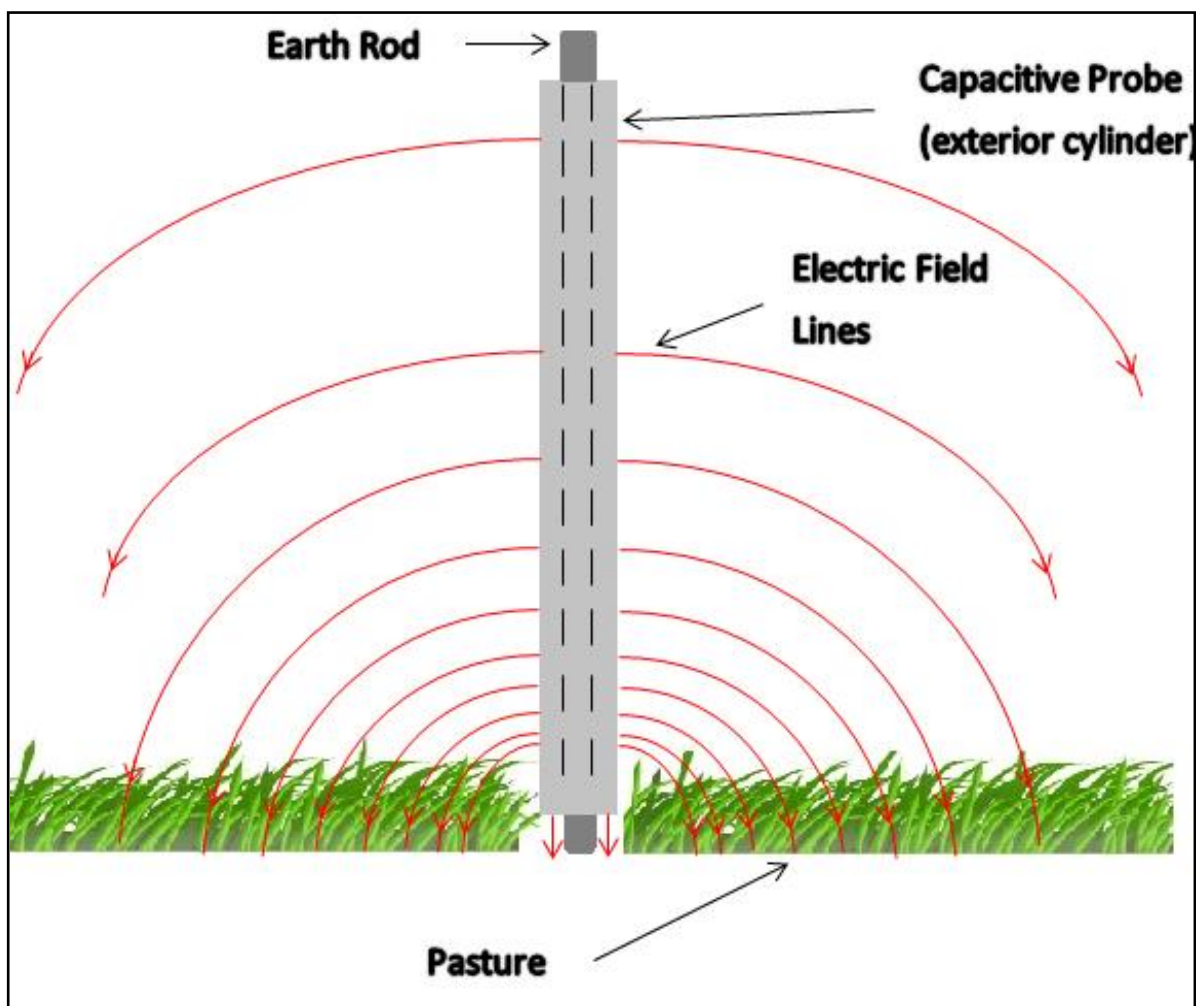
The capacitance probe system of measurement allows for these variations because the capacitance technique effectively measures the *volume* of pasture, not just its surface area or height. It does this by measuring the overall water mass near the probe, utilising the high dielectric constant of water.

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2. Features

- Simple one-handed operation.

- Easy to use keypad.

- 16 character by 2 line backlit LCD with audible 'beep' prompt.

- Calculates dry matter in kilograms per hectare (or pounds per acre).

- Stores results for up to 200 paddocks.

- No data loss, even with a flat battery.

- 3 different measurement modes.

- User adjustable automatic calibration for different pasture conditions.

- Internal NiMH battery.

- Universal/USB Battery charger included: no risk of over-charging.

- Auto power-off when not in use.

- Low battery warning.

- Downloading of paddock information with USB interface.

- Fully waterproof and detachable indicator.

- UNDO facility for removing accidental / incorrect measurements.

- Computer interface uses GrassTrack software for the Pro model.

- Import data (paddock names and areas) to GrassTrack from GrassMaster Pro and vice versa.

- Automatic sampling when grounded, using an accelerometer.

- Paddock readings can be taken from a quad bike if required.

3. Quick Start Guide

Kit Contents

The GrassMaster Pro will arrive complete with:

- GrassMaster Pro indicator.

- Capacitance probe assembly.

- Bottle of GrassMaster polish and cotton cloth.

- Universal USB/AC Charger and download cable.

- User manual.

- Carry bag.

- GrassTrack computer software CD.

- Soil/grass Temperature probe and booklet.

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Charging the Battery

To charge the GrassMaster Pro, simply use the USB charging cable provided and plug the GrassMaster Pro into your computer via a USB port, or into the Universal USB/AC Charger supplied. The GrassMaster Pro will show that it is charging on its display. Fully charging the GrassMaster Pro will take around 16 hours from dead flat.

You should receive your GrassMaster Pro indicator with a partially charged battery pack, it should have enough charge for a quick paddock test. However, the GrassMaster Pro should be charged before it is used for the first complete farm walk.

Assembly and Probe Preparation

Note that the GrassMaster Pro system uses the same probe assembly that was sold with the earlier GrassMaster II units. Slide the GrassMaster Pro indicator onto the probe and click into place. The indicator must be fully engaged to ensure that the contacts align with those on the probe. If the indicator and probe are not fully engaged when measuring, the PROBE NOT CONNECTED error message will appear.

Assemble the GrassMaster Pro by sliding the indicator onto the probe until it clicks in place.

Wipe the probe with the supplied polish and cloth before each use.

Taking Measurements

Always hold the GrassMaster probe by the black foam handle when taking measurements.

Turn on the GrassMaster Pro by holding down the *[Power/Exit]* button.

Upon initial start-up, the GrassMaster Pro will default to the **Quadrat Estimate** equation type (See page 14, Selecting Equation types if you want to change this).

(Note that the computer software package GrassTrack allows you to easily setup the GrassMaster Pro with your custom paddock names, areas, and forage types. See later sections).

1. Press *[Measure/Enter]* to begin.

2. Select the paddock you want to measure using the *[Up/Down]* arrows and press *[Measure/Enter]* to select.

3. If this is the first time the instrument (for this forage type) has been accessed today, the GrassMaster Pro will display:

```
–  CREATING NEW  –
–    EQUATION    –
```

 followed by:

```
–  LOW QUADRAT  –
–  PRESS Enter  –
```

Press *[Measure/Enter]* and the GrassMaster Pro will perform an air reference reading. Hold the probe (by the black grip) in the air, away from any objects, while this process runs for a few seconds. It will make a special beep if all OK.

4.   The GrassMaster Pro will then ask for at least 10 samples. Select a small area of representative low grass cover (usually about 0.5m2 or less) that includes the forage types over most of the farm (e.g. Rye/Clover). Take samples of this area by grounding the probe vertically with a small force, in slightly different areas of the plot. When you have finished press *[Measure/Enter]* to find the average instrument reading.

5.   You will now be asked to **JUDGE LOW COVER.** Using the *[Up/Down]* arrows, adjust the drymatter amount shown on the display, to what you estimate is present. Press *[Measure/Enter]* to confirm.

6.   *High Quadrat* measurement will be next, press *[Measure/Enter]* to continue and the GrassMaster Pro will perform an air reading, hold the probe (by the black grip) in the air away from any objects while this completes.

7.   Select a small area of HIGH grass cover, also representative of the forage mix on most of the farm. The GrassMaster Pro will then require about 10 probe samples of this area, usually a grid or quadrat less than 0.5m2.
When you have finished taking samples, press **[Measure/Enter]** to average the readings.

8.   You will now be asked to **JUDGE HIGH COVER.** Using the **[Up/Down]** arrows, adjust the dry matter amount to show what you estimate is present.
Press **[Measure/Enter]** to confirm. Use care with these estimates.

NOTE: Try to have a minimum difference of at least 2000kg/Ha between LOW and HIGH quadrats that you choose, for better accuracy.

9.   The Average Min and Max CMR (internal instrument) readings will be displayed. Press **[Measure/Enter]** and the GrassMaster Pro will then calculate the linear equation for the measurements you have taken. Check that the equation looks reasonable compared to examples in the manual (similar slope and intercept range).
Press **[Measure/Enter],** to continue.

10.   *TEST EQN NOW?* Before taking normal paddock measurements, you have the option to test the equation.
Press **[MEASURE]** to Test Equation (Step 11) or **[Undo]** to skip and begin taking forage measurements (Step 13).

11.   **TEST EQUATION** – Take samples of the forage around you (an area that might have average cover between the low and high test plots). Every measurement will display the drymatter amount based on the new equation.
Press MEASURE to display the average drymatter reading in kgDM/Ha. Check that it looks sensible. Press **[MEASURE]** to continue.

12.   **Redo EST EQN ?** If you are unhappy with the Equation, press **[Undo]** to redo the Equation (returns to Step 3) or [**MEASURE]** to continue.

[POWER/Exit] *button can be pressed at any time during the **(CREATING NEW EQUATION)** process to exit and return to the home screen.*

13.   The Following is displayed on the Screen:

```
 ╭─────────────────────────╮
 │  -READY FOR WALK-       │
 │  -  PRESS ENTER -       │
 ╰─────────────────────────╯
```

14.   The GrassMaster Pro then takes another air reading - hold the probe in the air, away from any objects, while this completes.

15. Start taking samples in your paddock. Lower the probe vertically into grass with a small force to prompt samples to be taken, and then lift clear of the grass a short distance. Use the probe as a walking stick, placing it down every 2-3 steps. If a reading has been taken correctly, it will beep once.

Sample Number and **Kgs/Ha** for that sample are displayed.

We recommend taking at least 60 to 70 samples while walking across the paddock diagonally, or by walking in a loop. (For quadrats or forage species trials, fewer samples can be used per block).

While taking samples you can:

- **PAUSE** the GrassMaster Pro by pressing the *[Menu/Pause]* button. (Press *[Menu/Pause]* again to continue).

- **UNDO** the last reading by pressing *[Undo/Next]* to remove the last sample (if required).

16. When finished press *[Measure/Enter]* and the **average KgDM/Ha** is displayed (this is the data that will be saved for that paddock).

The GrassMaster Pro will now be ready for the next paddock.

To exit measure mode press *[Power/Exit]* and the GrassMaster Pro will return to the main screen.

The '**CREATING NEW EQUATION'** calibration procedure only automatically occurs for the very first time each grass type is used for a paddock, on each day of a farm walk. After this first time, you will be asked if you want to update the estimate equation.

After selecting the paddock, the age of the current equation will be displayed, to help you decide if the estimate needs to be updated. Normally you will continue to use the same calibrated equation from the start of the farm walk.

4. More detailed explanation

Probe Preparation and Care

Prior to measuring every paddock, wipe the lower 60 cm of the GrassMaster probe using the antistatic and dispersant cotton cloth with oil, taking particular care to clean the grounded metal end of the probe.

> **Tip! Always take the GrassMaster oil (Inox) and cotton cloth with you.**

Inox is a good dispersant and provides antistatic protection for the probe contacts. You will find that the GrassMaster Pro is sensitive to large water globules or an accumulation of dirt on the tip. A correctly oiled GrassMaster Pro will allow only small and well dispersed water droplets to adhere to the probe when used in moist conditions. Avoid wiping GrassMaster Pro oil onto the indicator and probe contacts at the top of the probe assembly, as this may interfere with readings, and the WIPE PROBE & TIP error message may appear.

It is important to use only cotton materials for your cloth, as synthetic materials will cause static electricity build-up which may influence the GrassMaster's pasture readings. Also ensure there are no deep scratches or cuts on the lower half of the probe. Nylon scouring pads and cut 'n' shine car polish can be used to restore a smooth finish to the probe. With regular use of the polishing oil provided, a very smooth and protective barrier will begin to develop, vastly minimising error-causing dirt and moisture adherence to the probe, which makes the farm walk more productive.

You might get even better results by spraying an extra coating of oil onto the probe end before starting a paddock walk.

Best Time to Measure

It is best to measure when conditions are dry, typically in the afternoon, once dew has lifted and wind has dried the pasture. The GrassMaster readings will then be more consistent and accurate, although the probe can be calibrated for any conditions. You should avoid using the GrassMaster Pro after it has been raining.

Warning:

Avoid touching live electric fences with the probe end of the GrassMaster, as the electrical surge may damage sensitive internal electronics. Damage to the GrassMaster from an electrical spike like this will be readily apparent when servicing, and is not covered under the warranty.

Selecting Equation Type

The GrassMaster Pro has three different types of equations you can choose to use:

- **Quadrat Estimate (Default)**
  Low and high end estimations (or Cut Weigh and Dry measurements) are entered so the GrassMaster can draw a line between these two points to create an equation. See Taking Measurements section of the Quick Start Guide (page 9).

- **Fixed Equation**
  You can also manually enter a fixed equation for the GrassMaster Pro to use. See Fixed Equation (below).

- **Environmental**
  The GrassMaster Pro uses a series of environmental readings and conditions to automatically determine the equation to be used. See Environmental Equation (page 15).

To change the equation type, complete the following:

With the GM in the main screen press *[Menu/Pause],*
Continue pressing *[Menu/Pause]* until you see **2. SETTINGS**
Press *[Measure/Enter] to* select the Settings menu*.*
Use the *[Up/Down]* arrows until you see **2.5 SELECT EQUATION TYPE**.
Press *[Measure/Enter]* to select this.
Use the *[Up/Down]* arrows until you see the equation type you wish to use.
Press *[Measure/Enter]* to select this equation type.

Fixed Equation

Most users will use a recommended equation for each forage type, provided by previous Novel Ways data, but if you have CWD data from very recent paddock work, you can generate the most accurate equation for today's conditions.

This type of equation is the same system used on earlier models of the GrassMaster.

Changing the 'y=mx +c' equation

Press *[Menu/Pause]* until you see 1**. TASKS** and press *[Measure/Enter]*
Use the *[Up/Down]* arrows until you see *MODIFY EQUATIONS* press *[Measure/Enter]*
Press *[Measure/Enter]* and the cursor will flash beside the Equation Letter
Press the *[Up/Down]* arrows to select the fully customisable equation, I

Press **[Measure/Enter]** and the cursor will flash over the Multiplier (M)

Press the **[Up/Down]** arrows to adjust the multiplier

Press **[Measure/Enter]** and the cursor will flash over the +/- symbol

Press the **[Up/Down]** arrows to toggle between +POS and –NEG. Normally this is negative

Press **[Measure/Enter]** and the cursor will flash over the intercept (C)

Press the **[Up/Down]** arrows to adjust the intercept (normally 0000 to 0400)

When you have finished press **[Menu/Pause]** to exit back to the Menu screen

OR

Press **[Power/Exit]** to fully exit the menu and back to the main screen.

Environmental Equation

When you have selected the Environmental equation in the settings menu, the GrassMaster Pro will perform the following calibration sequence at the start of each day to set the equation for that particular day (It is usually only done once at the start of each day).

1. Press **[Measure/Enter]** to begin measurements.

2. Select the paddock you want to measure using the up and down arrows, and press **[Measure/Enter]** to select.

3. Select the forage type using the up and down arrows, and press **[Measure/Enter]** to select.

4. Set the approximate Dry Matter % of the forage for today. This is a 10 step scale ranging from 'wet' to 'dry' displayed as a bar graph. This adjusts the slope of the equation in use for today. You can leave this at the default setting (mid range) if you are unsure, or alter by using the up and down arrows it and press **[Measure/Enter]** to confirm.

5. Next you will be asked if you want to take air and soil readings. These are used so the probe can differentiate between moisture in the grass and moisture in the soil, which is not relevant to predicting dry matter. Press **[Measure/Enter]** to take these readings or **[Undo/Next]** to skip this step (Go to step 9 if you choose to skip).

6. The GrassMaster Pro will first take an air reading. Hold the probe (by the black grip) in the air away from any objects while this completes.

7. The GrassMaster Pro will then require up to 10 low cover readings. To do this, probe patches of very low cover forage with the probe tip until you have taken enough samples (we recommend 10) to get a good average. Press **[Measure/Enter]** to finish taking low cover readings. To undo a sample at any time, press **[Undo/Next]**.

8.   The GrassMaster Pro will then average the low cover readings and display the low cover CMR it has detected. You will then be prompted to save this low cover CMR. Press *[Measure/Enter]* to save (or *[Undo/Next]* to cancel the low cover reading).

9.   The GrassMaster Pro will then display the equation for today as determined by the procedure above. Press *[Measure/Enter]* to proceed.

10.   The GrassMaster Pro then takes another air reading, hold the probe in the air away from any objects while this completes.

```
 -      START      -
 -    YOUR WALK    -
```

11.   Then, is displayed on the GrassMaster screen.

12.   Start taking samples in your paddock. Lower the probe vertically into grass with a small force for samples to be taken, and then lift clear of the grass a short distance. Use the probe as a walking stick, placing it down every 2 - 3 steps. If a reading has been taken correctly, it will beep once.

Sample Number and **Kgs/Ha** for that sample are displayed.

We recommend taking 60 to 70 samples while walking across the paddock diagonally or in a loop. (For quadrats or forage species trials, fewer samples can be used per block).

Probe Measuring Technique

Once the probe has been wiped and oiled, it is ready to take the air reading.

Press *[Measure/Enter]* to start paddock selection. The following assumes the first paddock calibration has been completed.

Press the *[Up/Down]* arrows to select different paddocks.

Press *[Measure/Enter]* to choose the selected paddock. For information on how to change paddock names and areas, see Setting up paddocks in GrassTrack.

Hold the GrassMaster in the air about 30 cm above the ground and pasture, with the vertical probe at least 30 cm away from your body.
Press *[Measure/Enter]* again to confirm OK to delete previous data and initiate the air calibration.

The indicator will beep when air calibration is complete and you are ready to proceed with pasture measurement.

If the GrassMaster beeps and the error message WIPE PROBE & TIP appears, there may be dirt on the tip of the probe, or too much water, or not enough GrassMaster oil. Wipe the probe, paying particular attention to cleaning the tip, respray with oil, and then press **[Measure/Enter]** to continue. The GM Pro will generally ask for a new air reading.

When taking air or grass readings, hold the probe using one hand on the black sponge handle only, ensuring the probe is at arm's length from your body. Place the probe positively and firmly into the pasture, so the metal earth rod contacts the ground well. Make sure the probe is vertical in the sward when reading, and then lift it well clear of pasture between readings. Move straight to the next reading once the GrassMaster has indicated the sample has been taken (don't leave it grounded).

Commence actual measurement by vertically lowering the probe quickly and precisely into the pasture sward in front and to one side of you. Take at least 50 individual measurements per paddock, more if possible. Walk past the GrassMaster Pro while it's reading – this speeds up the pasture walk and ensures the probe is kept as vertical as possible in the pasture sward. It is not critical to keep the GrassMaster completely vertical for accurate readings, just within reason.

Lift the probe well clear of the pasture sward and repeat the process. The lifting process resets the probe for the next sample, and also tests for dirt on the tip.

Do not allow the bottom of the probe to drag through the pasture between measurements, because as mentioned, the probe looks for an air reading free of interference, in between samples. Observe each sample on the LCD for the first few readings.

Press **[Undo/Next]** to remove any false readings (which will usually be very low or very high). These are signified with a double pip signal, it's up to you to check and accept these, or delete them.

Do not hold the GrassMaster too close to your body because this may influence the GrassMaster's readings. Hold the GrassMaster in a comfortable vertical position at least 30 cm away from your body.

To finish this paddock press **[Measure/Enter].** The average dry matter yield will be displayed in kilograms per hectare. The calculated average cover, equation being used, the raw CMR readings (corrected meter readings) and the date will all be stored in the GrassMaster's paddock memory. The GrassMaster will then automatically change the display to the next paddock for measurement.

Sixty samples taken per paddock should be adequate for a good repeatable average, this is usually done in a diagonal path across the paddock. When measuring clumpy grass, probe on the outside perimeter of the clump if possible, to give a proper probe grounding. Probing the centre of the clump of grass prevents the probe from reaching ground level, resulting in a significantly lower reading.

Pausing the GrassMaster and removing data values

To temporarily stop taking readings within a paddock, perhaps to shift a temporary fence, press *[Menu/Pause]*. Press *[Menu/Pause]* again to resume taking readings for the paddock. Any low or inaccurate readings (caused by letting the probe touch sward between sampling) are usually detected by a doubling in the sampling "beep"; you can use the undo button to erase that error and then continue the walk without losing any previous data.

Paddock Memories

The GrassMaster has 200 paddock memory locations (400 paddock option due soon). These are displayed sequentially in a continuous loop. Press the *[Up/Down]* arrows to cycle through the paddocks. Paddock numbers and names can be used. To change the name and area of paddocks, see Setting up paddocks in GrassTrack.

Readings per Paddock

Sixty to seventy readings is the minimum number ideally required to get a statistically sound average reading from a paddock. Take more readings for high pastures, as they tend to be more variable in cover. The GrassMaster will allow you to take up to 250 individual readings in a paddock. It will then automatically calculate and record the average for that paddock. The number of readings taken is noted on the screen at each reading.

Manually entering Estimated Paddock Cover

Once you are in the paddock measuring screen (Press Measure and use the *[Up/Down]* arrows to select the paddock), you can manually enter an estimated paddock cover from eye estimate. Hold the *[Measure/Enter]* key down for a second, at the start of the paddock (before the first air reading). Use *[Up/Down]* arrows to adjust the figure in kgDM/Ha. It back-calculates CMR based on the equation in use and sets the sample count to zero, holding the current date. This can be useful for entering very recent changes before downloading data, or to speed up a farm walk in some situations.

Continue to a Different Paddock

Press *[Measure/Enter]* to end previous paddock, the average is performed automatically, then view average kgDM/ha. Press *[Up]* and *[Down]* to select a new paddock if needed (will jump to next).
Press *[Measure/Enter]* to start walk.

Complete all paddocks required.
Press *[Power/Exit]* to end. Press and hold *[Power/Exit]* again to shut down.

Adjusting Date and Time

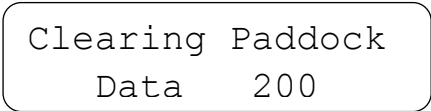The GrassMaster Pro adds the date and time to output data and dates all paddock readings.

- With the GrassMaster Pro in the main screen press *[Menu/Pause].*
- Continue pressing *[Menu/Pause]* until you get to   **2. SETTINGS**
- Press *[Measure/Enter]* and use UP/DWN buttons until you
  see 2.6 **ADJUST DATE AND TIME** screen*.*
- Press *[Measure/Enter]* and the ADJUST DATE screen is displayed and the cursor will be flashing on days.
- Press *[Measure/Enter]* to select month and use *[Up]* and *[Down]* if you want to adjust month.
- Press *[Measure/Enter]* to select year and use *[Up]* and *[Down]* if you want to adjust years.
- Press *[Measure/Enter]* and the ADJUST TIME screen is displayed.
- Use *[Up]* and *[Down]* to adjust the hours (24hour format)
- Press *[Measure/Enter]* to select minutes and use *[Up]* and *[Down]* if you want to adjust minutes.
- If you press *[Measure/Enter]* again the program loops around to adjust days again.
- When you have finished press *[Menu/Pause]* to save and exit back to the Menu screen
- OR press *[Power/Exit]* to fully exit the menu and back to the main screen.

Clearing Indicator Data

Two options will clear various data from the GrassMaster Pro indicator's memory. Paddock data cannot subsequently be recovered. Send the file to a computer program first, if data is needed.

Clear paddock data only: (holds the date/time, probe settings, but clears the paddock names, areas, last walk data etc).

- With the GrassMaster off, press and hold *[Measure/Enter]* key.
- Then press *[Power/Exit]* and you should see:

```
Clearing Paddock
   Data    200
```
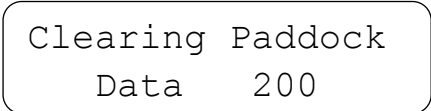
When the number reaches 0, the GrassMaster Pro paddock data will all be cleared.

Reset Indicator settings to default: (reverts to out-of-the-box settings, date/time lost, cleared paddock data etc.) Use only if necessary.

- With the GrassMaster off, press & firmly hold *[Up]* and *[Down]* and *[Menu/Pause]*
- Then press *[Power/Exit]* and you should see: "Loading Default GrassMaster Pro Settings" then

```
Clearing Paddock
   Data    200
```

When the number reaches 0, the GrassMaster Pro will have been successfully **reset.**

Storage and Care

The GrassMaster is a precision electronic device that should give many years of service if used with care.

- Separate the indicator from the probe by sliding the indicator forward when not in use.

- Clean and apply oil to the probe after use and store in a warm and dry place like an airing linen cupboard. Do this after each use, not just at the end of the season. Avoid high humidity storage situations like dairies and outside sheds.

The indicator housing is fully waterproof and should be cleaned with only water and mild detergent. Avoid touching the contacts on the rubber base with your fingers. Excess grime or GrassMaster oil on these contacts may lead to measurement error messages and downloading errors. Excess oil may be removed carefully with methylated spirits.

5. Downloading paddock data

After a farm walk has been completed using the GrassMaster Pro, the data collected can be downloaded to a computer. The data for each paddock includes the paddock number and name, dry matter in kilograms per hectare (or pounds per acre), relative capacitance value (CMR or Corrected Meter Reading), and other data relating to the measurements recorded. This information can be useful when using CMR data to derive your own calibration equations.


GrassTrack is free software supplied with the GrassMaster Pro. It is also available as a free download from the Novel Ways website (http://novel.co.nz/downloads.html). To install GrassTrack on your computer, insert the CD and start the setup file (or open the downloaded file) and follow the steps in the installation wizard.

Initial Setup

1. Install GrassTrack on your computer. Use the file on the supplied CD or download from: http://www.novel.co.nz/downloads.html (You may need to disable your antivirus software first).
2. Once installation is complete, run GrassTrack by clicking on the desktop icon, or by selecting GrassTrack from the Start-Menu programs list.
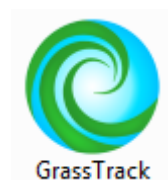
3. Connect your GrassMaster Pro to the computer using the supplied USB cable. GrassTrack will automatically detect the GrassMaster Pro, and the connection status shown at the bottom-left of the GrassTrack window will become green (Note that the COM port number may vary):

GM PRO Auto-connected on COM3

GrassTrack can be used to download recorded data to a computer, and to set up initial paddock settings (paddock number, name, area, grass type) on the GrassMaster Pro.

Setting up paddocks in GrassTrack

GrassTrack can quickly and easily create initial paddock settings, or edit previously stored paddock settings for the GrassMaster Pro.
1. Run GrassTrack, and ensure that the GrassMaster Pro is connected to the computer and to GrassTrack (as detailed in the previous section).
2. Select the **Upload** tab at the top of the GrassTrack window.
3. The upload table will be displayed. Click the **Add Paddock** button to prepare a paddock setting.
4. A blank entry will appear in the grid below. Values must be entered for all boxes (paddock number, name, area, grass type). The paddock number corresponds to a specific paddock in the GrassMaster Pro memory.
5. When the desired changes to the GrassMaster Pro paddock settings have been entered, click the **Upload to GrassMaster** button.

(Above: example of paddock settings)

Note that when uploading paddock settings to the GrassMaster Pro, paddocks previously stored in the GrassMaster Pro memory will be overwritten by new paddock setting entries from GrassTrack if the paddock numbers are the same.

For example, in the paddock settings created in the picture above, paddocks 1, 15, and 8 in the GrassMaster Pro memory will be overwritten with new names, areas, and grass-type values when uploaded from GrassTrack.

Downloading farm walk data using GrassTrack

When a farm walk has been completed using the GrassMaster Pro, the recorded data can be downloaded to your computer and stored using GrassTrack.

1. Run GrassTrack, and ensure that the GrassMaster Pro is connected to the computer and to GrassTrack (as detailed on page 16).
2. Select the **Download** tab at the top of the GrassTrack window.
3. The download screen will be displayed. Follow the on-screen instructions to download the farm walk data from the GrassMaster Pro.

GrassTrack stores data from all 200 paddocks for every download from the GrassMaster Pro. These sets of data are time-stamped with the date of their download.

Viewing downloaded data in GrassTrack

Following completion of a download from the GrassMaster Pro, the data can be viewed in GrassTrack or exported using either the **Data** or **Chart** tabs.

To select the farm walk data set for a specific date, click either the **Data** or **Chart** tab and select a date from the **Farm walk date** drop-down box. The dates shown correspond to the sets of data downloaded on those dates. GrassTrack loads and displays the most recent stored farm walk data set by default.

GM Paddock #	Name	Area (ha)	Entry date	Soil CMR	Raw air CMR	Sample count	Grass CMR	Grass Type	Dry matter %	Tempe (°
12	_Padd_#_012	2.2	12/03/2014 12:05:00 p.m.	1000	23012	22	2108	3	20	
13	_Padd_#_013	2.3	12/03/2014 12:05:00 p.m.	1000	23013	23	2117	4	20	
14	_Padd_#_014	2.4	12/03/2014 12:05:00 p.m.	1000	23014	24	2126	5	20	
15	_Padd_#_015	2.5	12/03/2014 12:05:00 p.m.	1000	23015	25	2135	1	20	
16	_Padd_#_016	2.6	12/03/2014 12:05:00 p.m.	1000	23016	26	2144	2	20	
17	_Padd_#_017	2.7	12/03/2014 12:05:00 p.m.	1000	23017	27	2153	3	20	
18	_Padd_#_018	2.8	12/03/2014 12:05:00 p.m.	1000	23018	28	2162	4	20	
19	_Padd_#_019	2.9	12/03/2014 12:05:00 p.m.	1000	23019	29	2171	5	20	
20	_Padd_#_020	3	12/03/2014 12:05:00 p.m.	1000	23020	30	2180	1	20	
21	_Padd_#_021	3.1	12/03/2014 12:05:00 p.m.	1000	23021	31	2189	2	20	
22	_Padd_#_022	3.2	12/03/2014 12:05:00 p.m.	1000	23022	32	2198	3	20	
23	_Padd_#_023	3.3	12/03/2014 12:05:00 p.m.	1000	23023	33	2207	4	20	
24	_Padd_#_024	3.4	12/03/2014 12:05:00 p.m.	1000	23024	34	2216	5	20	
25	_Padd_#_025	3.5	12/03/2014 12:05:00 p.m.	1000	23025	35	2225	1	20	
26	_Padd_#_026	3.6	12/03/2014 12:05:00 p.m.	1000	23026	36	2234	2	20	
27	_Padd_#_027	3.7	12/03/2014 12:05:00 p.m.	1000	23027	37	2243	3	20	
28	_Padd_#_028	3.8	12/03/2014 12:05:00 p.m.	1000	23028	38	2252	4	20	
29	_Padd_#_029	3.9	12/03/2014 12:05:00 p.m.	1000	23029	39	2261	5	20	
30	_Padd_#_030	4	12/03/2014 12:05:00 p.m.	1000	23030	40	2270	1	20	

The **Data** tab displays all information collected by the GrassMaster Pro for a given farm walk date (or download date) and displays them in a table that can be ordered by paddock number, dry matter values, or other data types. A farm walk data set can be exported as a spreadsheet for editing in other programs (using the **Export spreadsheet** button). Data in

the table can also be selected, and right-clicking a selection will present a drop-down menu with the option to copy the selected data to the clipboard. This data can then be pasted into text or spreadsheet programs.
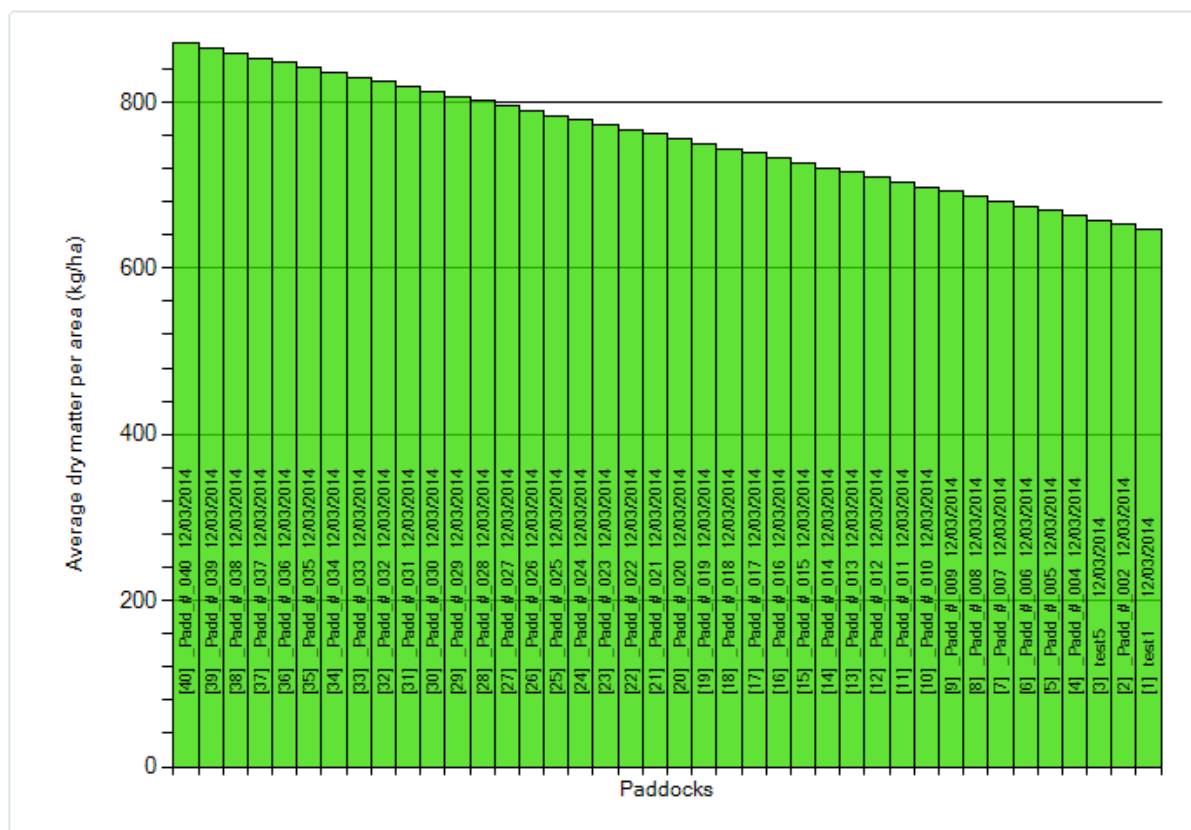
The **Chart** tab displays the current farm walk data set on a chart. A bar is shown on the chart for each paddock (excluding those with dry matter values equal to zero), and a feed wedge can be plotted using the options next to the chart.

In order to plot a feed wedge, pre-grazing and post-grazing values must be entered. There are two methods for calculating pre-grazing cover:

Method 1 for calculating *Pre-grazing cover*
(Stocking rate x Intake1/ x Rotation) + Optimum residual = Pre-grazing cover
(___ cows/ha x ___ kgDM/cow x __days) + _____kg DM/ha = _____ kgDM/ha
E.g. (3.0 cows/ha x 18 kg DM/cow x 22 days) + 1500 kg DM/ha = 2700 kg DM/ha

Method 2 for calculating *Pre-grazing cover*
(Cows x Intake1/) + Optimum residual = Pre-grazing cover
Area offered
(_____ cows x _____ kgDM/cow) + _____ kg DM/ha = _____ kgDM/ha
(____Effective area ÷ ____rotation length)
E.g. (300 cows x 18 kg DM/cow) + 1500 kg DM/ha
(100 ha ÷ 22 days)
(5400 kg DM ÷ 4.54 ha/day) + 1500 kg DM/ha = 2700 kg DM/ha
Note: 1/ Intake is pasture only

GrassMaster Pro User Guide

Calculating *Post-grazing cover*
The grazing residual needs to be a consistent, even height throughout the milking season. For ryegrass/clover pastures, the target is generally 1500-1600 kg.

Two chart types are available. **Average dry matter per area** and **Average dry matter**. Paddocks can also be ordered by their **Dry matter value** or **Paddock number**.

To plot a feed wedge line on the chart, enter pre-grazing and post-grazing cover values in the **Feed wedge** section of the **Chart** tab, and click the **Plot** button. A blue line will appear on the chart representing the pre-grazing and post-grazing values entered.

The chart can also be printed or saved as an image by clicking the **Print current view** button.

See the **Help** tab for more detailed instructions on using GrassTrack:

Data	Chart	Download	Upload	Options	Help

Help Topics

Connecting the GrassMaster Pro to GrassTrack

Downloading farm walk data from the GrassMaster Pro

Uploading paddocks to the GrassMaster Pro

Using the farm walk data display grid

Using the farm walk chart

About GrassTrack

6. Extra for Experts

How the Dry Matter is Calculated

The dry matter is calculated by the probe software using a linear (y=mx + c) equation. In this two-variable equation, y represents the predicted Dry Matter in KgDM/Ha and x represents the CMR, or corrected meter reading. The accuracy of this equation can be observed in spreadsheet software, when calculating the R^2 value of the probe data against paddock samples. R^2 is the coefficient of determination, and
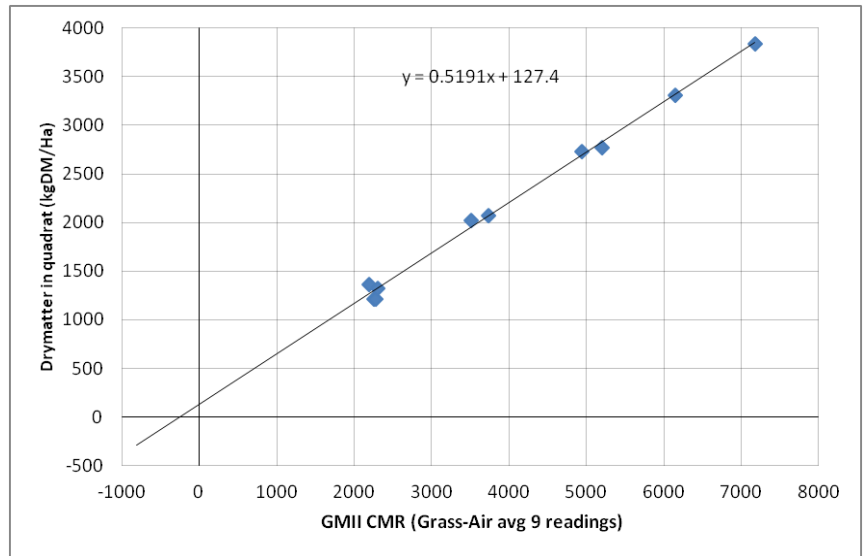
it is a measure of how well the regression line represents the data. If the regression line passes exactly through every point on the scatter plot (R^2=1), it would be able to explain all of the variation.

A fixed linear equation can be very accurate on a given day in particular forages. The best accuracy with the GrassMaster Pro is achieved by matching the equation in use with the seasonal changes observed, for the forage being measured.

Adjusting the Calibration- Creating a customized equation

If you wish to create your own linear equation that is specific to your farm and during a part of the season, the following Cut Weigh Dry method could be carried out.

Equipment
GrassMaster Pro
$0.2m^2$ wooden quadrat (internal square: 44.7cm x 44.7 cm)
4 inch nail
Scissors
Craft knife
Large zip lock bags
Recording sheet
Felt tip marker and pen
Scales (resolution 0.1g, capacity 2kg)

Method of Data Gathering

1. First, very low pasture cover readings could be taken and averaged to find the soil moisture background reading of the paddock. We suggest that the temporary equation (I) set on your GrassMaster is 0.5 * CMR with no offset (to simplify the required calculations). The kgDM reading is then half the actual CMR average.

2. Use a small area of bare dirt or well trampled forage for each sample – take 40 GrassMaster probe measurements in total, and average. (Record for reference).

3. Next the actual grass samples are taken, using quadrat sections. For each sample (select a range of forage covers from low to high), follow this procedure:

4. Place your wooden quadrat over an area of grass, and pull any blades of grass that partly protrude underneath the wooden edges, into the square area.

5. Use the GrassMaster Pro to take 9 readings in the square section, and then find the 'Dry Matter' average by pressing Enter. Check with a second lot of 9 readings if you want to, it doesn't take long. The CMR will be calculated later.

6. Use the scissors to cut the forage down to ground level, collecting all grass in the large bags and recording what number paddock(s) it is recorded as on the GrassMaster Pro memory list, on the sheet and on the bag. Repeat for all quadrats.

7. Manually remove any dirt, leaves and sticks carefully from the grass samples without losing green material. Weigh each quadrat while it is wet, and record the data.

8. Cut grass samples into shorter lengths (around an inch).

9. Heat and dry the entire sample of grass for each quadrat in an oven at 100 degrees Celsius for 24 hours.

10. Record dry weights (the dry matter content of the quadrats). Note that the dry matter percentage of each quadrat can be calculated in this method, as washing the soil from the grass would have affected the initial (green or wet) weight of the sample.
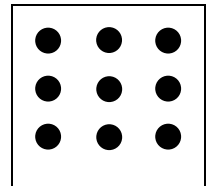
DM Calculation example:

$1 \text{ Ha} = 10,000\text{m}^2$

0.2m^2 samples taken

hence, a quadrat is 1/50,000 of a hectare

If there was found to be 45g of dry matter in a single quadrat:

50,000 x .045 kg dry matter will equal the amount in one hectare of similar cover

therefore: DM = 2,250 kg DM/Ha for that quadrat

11. Calculate CMR values for each DM value produced by the GrassMaster Pro by using the equation (CMR = 2 x DM) or uploading data to GrassTrack – the CMR readings will be in one of the data columns.

12. Once all the data has been collected, transfer into Excel and create a graph of CMR calculated by the GrassMaster Pro versus DM calculated by the CWD method. Highlight the

CMR and DM column by clicking and dragging the mouse, go to the Graph tab and select Line graph.

The DM should be represented on the y axis and the CMR should be on the x axis. Fit an equation to this line, and this will be your specific equation. To do this, 'right click' the data points and click 'Add trendline' then 'linear'. You will be able to see how well the equation fits by visually examining the graph, as well as interpreting the R and R^2 values. The closer they are to 1, the better the equation fits the data and hence the more accurate the GrassMaster Pro is in predicting the Dry Matter on that day. CWD data sets gathered in a short space of time, on consistent paddocks, can be very tightly predicted by GrassMaster quadrat averages as described above.

Background Conditions

Environmental Equation Only

Estimate Forage Dry Matter % (Affects DM Data)

When prompted for a Forage DM%, estimate this on a ten point scale that ranges from wet to dry. If you do not wish to account for variation in DM%, just always leave this setting on MEDIUM (5 or 6).

Background Soil Moisture (Affects DM Data)

For the first measurement of the day you will have to measure the background soil moisture before paddock sampling (unless you are in GM2 mode, settable from the Main Menu- Change Trigger Settings). It is also recommended that you take a new background measurement whenever you suspect that the soil type or moisture has changed between subsequent paddock measurements. Background soil moisture is measured by either measuring over bare soil, trampling grass flat, or ripping out a patch of grass of about the size of a dinner plate and measuring from this. Take at least 10 readings for more accuracy.

Example of a quadrat being probed

Example Equations

Most of the trial work that has been carried out with the GrassMaster products since 1996 has been on ryegrass/clover paddocks. CWD data has been fitted to readings of several weeks or months, and more recently, daily data clusters. Very strongly correlated linear equations result from data taken over short time periods. This means that on a given day, the GrassMaster Pro will be able to grade paddocks of similar forage type extremely well.

The whole point of the GrassMaster Pro development is that this trial work can be extended, so that the probe software can produce a tuneable linear equation for each forage type, all through the seasonal changes that are seen. This means that users will achieve indicative paddock drymatter figures that approach the actual values as assessed by CWD techniques, which are very time-consuming.

For ryegrass/clover mixes in NZ, an indicative equation that suits green growing paddocks with moist soils, is

DM = 0.4800x CMR -300 kg DM/Ha

This is a good reference point. On a day when the soil is dry on the surface, the negative offset or intercept will normally be closer to zero kg, as the GM Pro sees no water in the top soil layer. This is the purpose of the low cover readings taken at the start of the first paddock. The procedure automatically adjusts the offset. The offset should range from 0000kg to about minus 500kgDM/Ha at the most.

Similarly, ryegrass is known to have a range of 8-35 DM% through NZ conditions, especially on unirrigated pastures. In New Zealand on ryegrass/clover sward, we have observed this to cause the slope or multiplier of the GM Pro equation to range from 0.35 (wet) to 0.85 (dry). The bar graph setting will make these changes for you.

Other forage types will have similar ranges in their equation slopes, and over time this field data will be added to the predictive equations held in the GM Pro.

We suggest users make incremental changes in the equation slope setting if readings for a paddock residual look too low or high, and also check that the low cover reading has been done correctly. On paddocks with higher cover, the multiplier or slope has more of an effect on the average, so the DM% setting could again be looked at (Environmental Equation). Once you have a suitable equation for both lower and higher cover paddocks, you should be able to leave it in place for all paddocks in the farm walk on that occasion, as long as the forage type is the same.
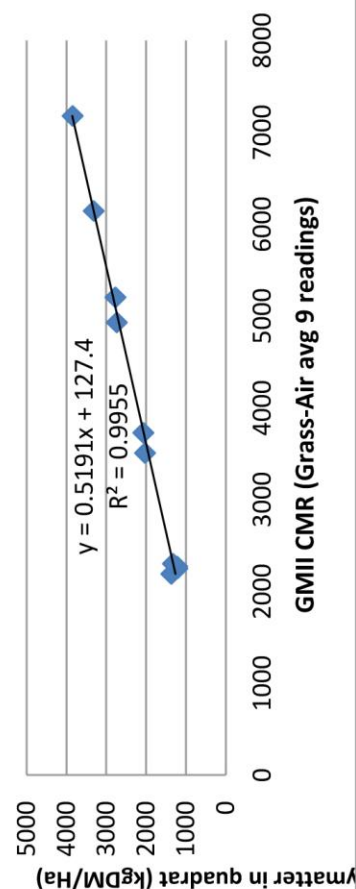
Drymatter Estimation Data in 2012, GrassMaster vs RPM (Rising Plate Meter)

Largely Chicory (juvenile) mix, small amount of ryegrass. Very stable low ground moisture under all 10 plots is likely, paddock measured before and after grazing.

Plots were 0.2m2, or 44.72cm inside x 44.72cm. One RPM plate reading, average of 9 x GM readings. CMR standard

Probe type: GMII, serial no. 21134. Grass was dried in 2 containers, DM% on small quadrat of ryegrass (20%DM) and Chicory (10%DM) affected results.

10 plots were evaluated in the one paddock over the course of a day, quadrat cuts 1-6 pregrazing, 7-10 post grazing.

Date of evaluation: 11th January 2012. Location: a dairy farm, Hamilton. Weather: had been wet over Christmas, surface fairly dry.

Quadrat No. 0.2m2	Wet weight (washed) (grams)	Dry weight (grams)	DM% (part sample)	RPM clicks (half cm)	Yield kgDM/Ha	Soil temp @ 15cm, degC	GMII CMR Grass-Air	Yield kgDM/Ha	GMII predict y=mx+c	GMII Error, kg	RPM Predict	RPM Error, kg
1	523.61 + 2nd washed	76.9	12.41	35.6	3845	20	7180	3845	3855	10	4016	171
2	262.84 + 2nd washed	55.4	12.06	20.8	2770	20	5203	2770	2828	58	2490	280
3	184.12 + 2nd washed	54.7	18.41	26.4	2735	20	4930	2735	2687	48	3067	332
4	432.62 + 2nd washed	66.3	9.41	22.4	3315	20	6144	3315	3317	2	2655	660
5	79.41 + 2nd washed	40.5	20.02	12.8	2025	20	3507	2025	1948	77	1665	360
6	123.45 + 2nd washed	41.4	16.44	18.8	2070	20	3728	2070	2063	7	2283	213
7	washed	24.3	14.8	11.2	1215	21.5	2248	1215	1294	79	1500	285
8	washed	24.4	14.8	10.8	1220	21.5	2271	1220	1306	86	1458	238
9	washed	27.3	14.8	10	1365	21.5	2190	1365	1264	101	1376	11
10	washed	26.5	14.8	10	1325	21.5	2301	1325	1322	3	1376	51

Avg error, kg   47   260
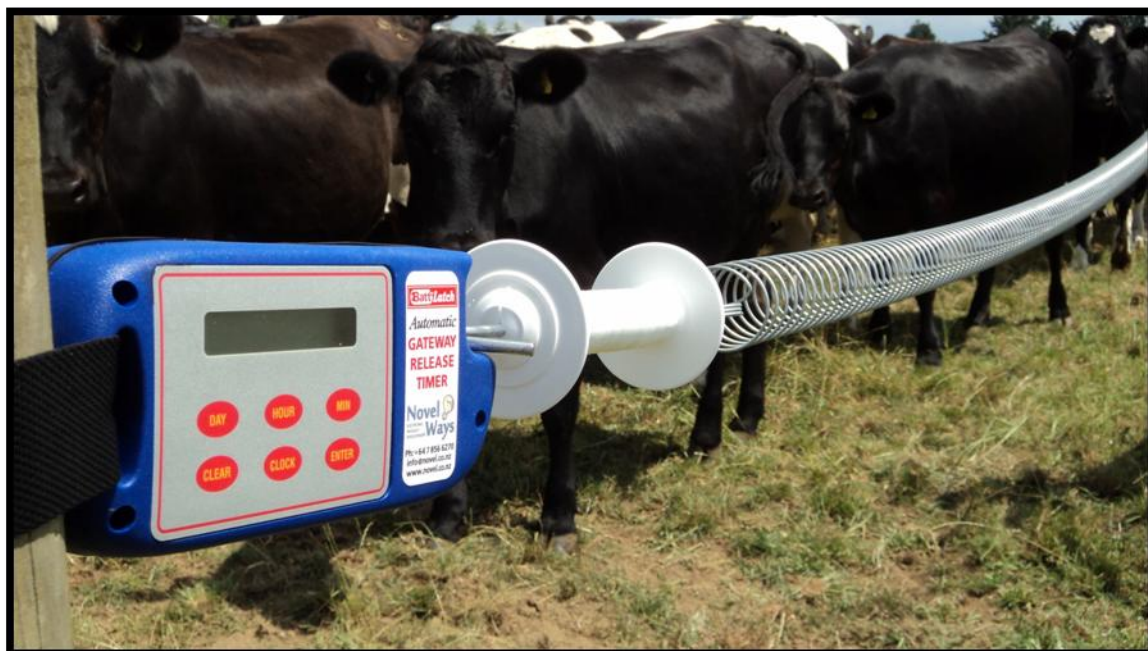Worst error   101   660

RPM Results 11th January 2012
y = 103.12x + 344.77
R^2 = 0.8787
Drymatter in quadrat (KgDM/Ha) vs RPM Clicks (one reading)

GrassMaster II Results 11th January 2012
y = 0.5191x + 127.4
R^2 = 0.9955
ymatter in quadrat (KgDM/Ha) vs GMII CMR (Grass-Air avg 9 readings)
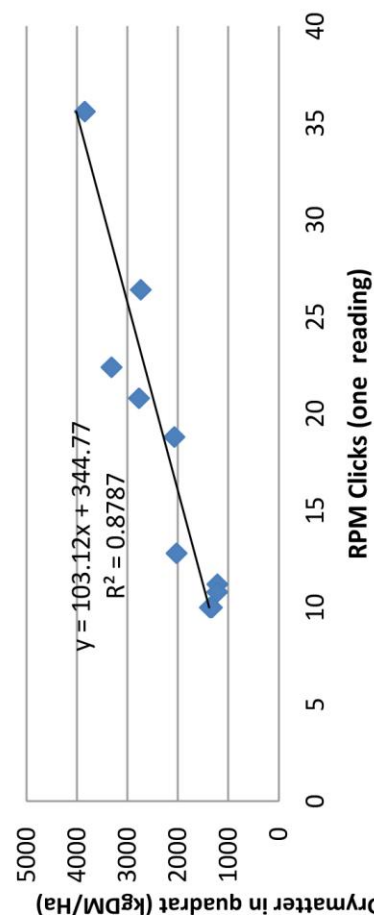
6. Other Novel Ways Products

 ***Automatic* Gateway Release Timer**

Optical Brix Refractometer Kit