

A Pasture Cut Weigh and Dry Protocol for use with the GrassMasterPro for equation calibration purposes

Tools required

GrassMaster Pro

quadrat 50cm x 50cm – see details below

Grass Shears (battery operated or Hand)

Plastic or paper rubbish bags – 10 to 20 litre volume

Permanent marker to label rubbish bags

Notebook and pen for any notes

Electronic Kitchen Scales eg 0 to 3000 grams, resolution to nearest gram

Kitchen microwave oven

Introduction

There appears to be no 'standard' protocol for a Cut, Weigh and Dry (CWD) sampling of pasture, despite CWD being cited as the 'most accurate method' or gold standard for pasture dry matter mass estimation.

The protocol below is one based on an amalgamation of several different protocol descriptions.

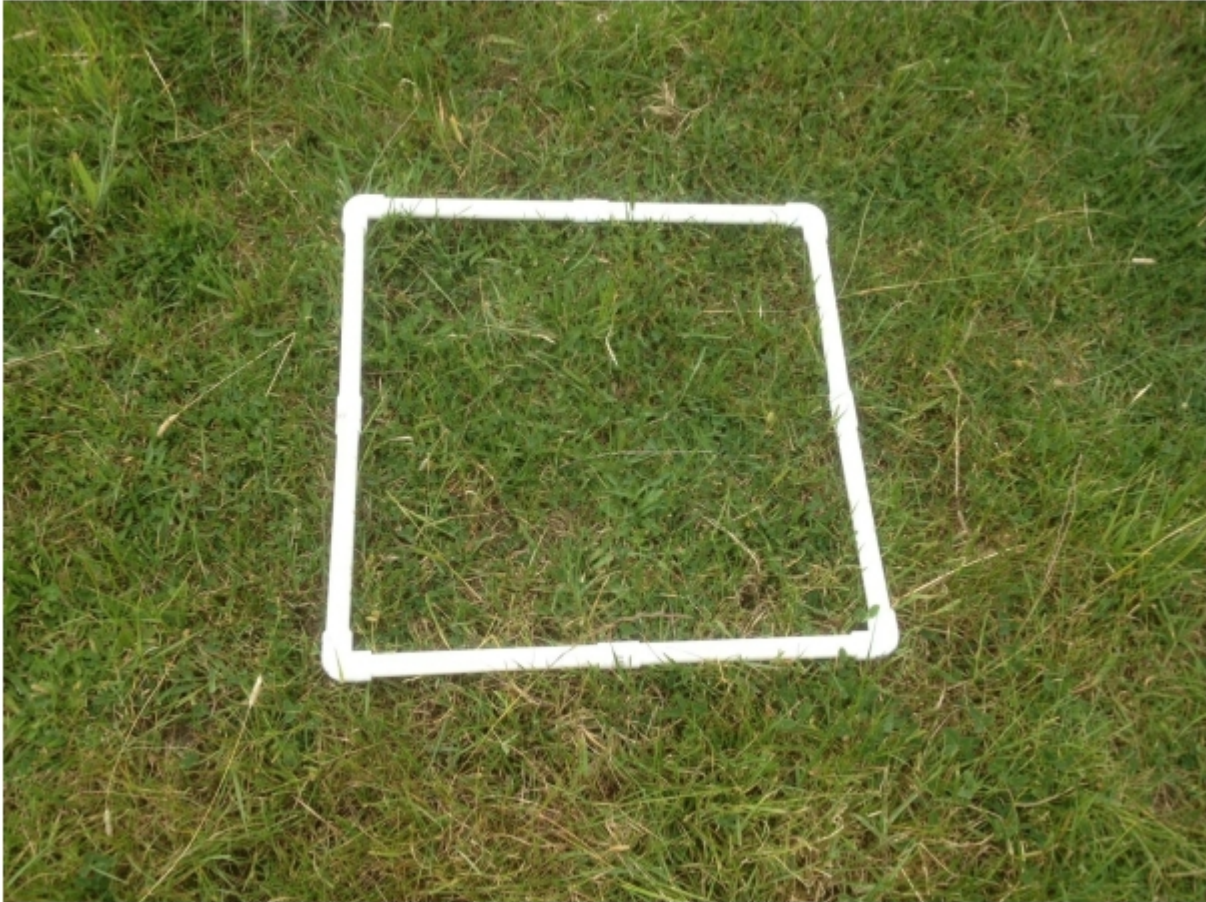
This protocol has the advantage that it uses a 50cm x 50 cm quadrat which is sufficiently large to minimize sampling errors while small enough to still be of practical use in the field.

(NB: An alternative protocol is also listed in the back of the GrassMaster Pro Manual. It may pay to read this to gain another perspective)

Quadrat specs

This can be made using 20mm PVC water pipe with 90 degree PVC elbows. Cut the pipe to length to ensure the inside length of each side measures exactly 50 centimeters (500 mm) when assembled. Glue with PVC cement when ready.

The resultant quadrat will be a 50 cm x 50 cm square (0.25 m²)



Steps in taking a CWD (Cut, Weigh and Dry) for calibrating the GrassMaster Pro.

1) Set up of the GrassMaster Pro

Set the equation type on the GrassMaster Pro to the fixed equation option – the GrassMaster Pro manual explains how to do this on page 10 of the manual.

Set the fixed equation to $DM = 0.4800x\ CMR - 300\ kg\ DM/Ha$
(this happens to be the standard fixed equation for ryegrass /clover)

Manipulating the fixed equation is explained on page 10 and 11 of the manual as well.

NB: Since it is the CMR (corrected meter reading) values that we use to calibrate the GrassMaster Pro against CWD's, it would be OK to use other fixed equations than that above. It is just that by setting the fixed equation to the standard often used for ryegrass /clover we will be using an equation of a known quantity which will be at least be functional and somewhat near to what we eventually end up.

CMR values and what they are will be explained later on in the document.

2) Selection of sample quadrat areas to probe

We want to preferably sample a minimum of three quadrat areas (although it is possible to do it with two, a low and high length).

I.e. choose a short, a medium and a long pasture length area for each quadrat sample.

Most pasture/paddock situations will allow you to find three such areas.

For EACH of the pasture length sample areas concerned, try and find an area where the grass growth is relatively even and consistent *across and within* the 0.25m² quadrat sample area. This will help to minimise errors.

3) Probing the quadrat

Place the quadrat over the sample area chosen –, starting with for example the 'low pasture' length sample quadrat.

Having set the GrassMaster Pro with the fixed equation as described above, select (say) 'Paddock 1' memory allocation and then proceed to take at least 9 probe readings or more with the probing distributed evenly *within* the 50 cm x 50 cm quadrat. Taking more probings is better and it should be quite possible to take up to at least 15 probes without unduly disturbing the pasture sward and introducing errors. Use operator discretion here.

Finish the probing by pressing the 'Measure/Enter' button and this will generate the average reading (kg DM/Ha) for that quadrat and it then automatically allocate to memory – in this example, 'Paddock 1'.

4) Cutting and collecting the herbage mass

Next step: Proceed to cut and collect all the herbage mass *within* that quadrat area as described below

Use good quality garden grass cutting shears (battery operated shears are really good for this or quality hand shears) and cut all the plant matter within the quadrat as close to the ground surface as practical, without cutting into the soil. Leave about a 1cm stubble, i.e., try to emulate a Hard grazing situation. There is no need to harvest all the stubble above the soil surface such as grass and clover stolons.

Collect all the plant matter within the quadrat into a bag and label .

A 10 to 20 litre volume (white) plastic rubbish bags or paper bags are ideal for collecting samples as they can be easily written on for recording purposes and are easy to cart around.

Put the filled bags aside for weighing later.



5) Repeat the whole probing and cutting and collecting process just described for the medium length and long length quadrat sample areas respectively. NB: Use 'paddock 2' and 'paddock 3' memory allocations (or any other memory allocations that are convenient) on the GrassMasterPro for each sample area respectively.

Important note on Dead Matter

If there is ALOT of pasture dead matter at the base of the pasture sward, as can happen during a very prolonged dry growth period- eg late summer, we strongly recommend that you **DO NOT** harvest and collect this for weighing or dry matter estimation purposes. Leave it or discard it. This is because the capacitance system that the GrassMaster Pro barely measures such dead matter. It does however measure actively growing (green coloured) pasture matter very well, even that of a high dry matter percentage (eg 50%) as one is likely encounter in mid to late summer dry conditions. Since the feeding value of dead matter is invariably very low, not accounting for deadmatter is of little consequence.

In such situations where there is a lot dead matter apparent in the sward, ensuring dead matter is not collected from CWD sampling will result in calibration equations that will very closely reflect useful pasture matter mass suitable for livestock feeding purposes.

Including dead matter will only result in calibrations that grossly over estimate the pasture mass that is actually of practical feed value.



The image above shows a pasture with (mostly) dead herbage left behind post harvest. This was a late summer pasture after prolonged dry period – with approx 55% dry matter content. By NOT harvesting the dead matter it was possible to derive a very accurate equation for the GrassMaster Pro that measured only that pasture that was useful for livestock consumption and production. Livestock that are forced to eat dead matter will not put on body weight and are even likely to lose body weight. Come the autumn rains, the dead matter will soon decompose.

Weighing and recording of quadrat bag samples.

Remember you will need to consider just the net weights of each quadrat sample. You will therefore need to take into account the weight of the collection bags when weighing.

Modern battery powered digital kitchen scales of 0 to 3000grms weighing range are ideal for this purpose. These are now relatively inexpensive to purchase and are remarkably accurate, right to the nearest gram, certainly enough for these purposes.

Measure the 'wet' weight of each quadrat sample and record

Table 1

Quadrat label (50cm x 50cm)	Nett 'wet' weight grams
A: Low pasture	119
B: Medium pasture	224
C : High pasture	402

Determination of Dry Weight

Since we are looking to calibrate the GrassMaster Pro in order for it to produce data in terms of drymatter per hectare, we need to determine the dry matter percentage of each quadrat sample.

The simplest way to do this is to take a sub sample of each quadrat and combine them into a sub-sample, then determine that sub-sample's pasture dry matter percentage. The determined value can then be used to determine the drymatter values of each quadrat sample wet weight, and then by converting each quadrat's area into per hectare terms, we can determine each quadrat's dry matter value in terms of kg DM/Ha

ie

1. sub-sample each of the 'wet' sample quadrats and combine into one sub-sample
2. measure the wet weight of the combined sub-sample
3. oven dry the sub-sample
4. weigh the oven dried sub-sample (in grams)
5. calculate dry matter percentage of the sub-sample
6. use this dry matter percentage figure to determine the drymatter weight of each quadrat
7. calculate the equivalent dry matter weight for each quadrat for one hectare (kg DM/Ha)

A comment on sub-sampling for drymatter estimation

When sub-sampling for the drymatter estimation, it is strongly recommended that the leafy portion only of the pasture sample be used.

The reason for this is that the stem portion of pasture can have a dramatically higher dry matter % values compared to the leafy portions. Including stems in a sample can dramatically skew dm% results particularly in short pasture situations where the stems can represent a much larger portion of the harvested sample. Since it is the leafy portion of pasture that livestock tend to graze (or should do), it is really the leafy portion of the pasture we want to focus on for determining a suitable calibration equation.

Also, again be sure to discard any dead matter from the sample. Dead matter also tends to have very high dry matter values which will only erroneously skew DM% results.

Oven drying using a microwave.

Include a small glass of water in the oven so to avoid the pasture sample from catching fire .

1. Record the nett weight of the 'wet' weight sub-sample.
2. Place it in the microwave on high for about 30 seconds to 1 minute, take out, let moisture steam off, then reweigh.

3. Repeat until the sample no longer loses weight.
4. It can now be considered 'dry'.
5. Weigh dried material and record.

Example calculation for percentage dry matter

Calculate dry matter: If a sample weighs 100 grams nett fresh and 20 grams nett dry, it is (20 divided by 100) multiplied by 100 = 20% dry matter (the remaining 80% was water driven off during drying).

Conversion of quadrats to dry matter:

Worked example for a 0.5m x 0.5m quadrat.

291g of wet grass multiplied by 20% dry matter =

$$291 \times 0.20 = 58.2 \text{ g dry matter per } 0.25 \text{ m}^2.$$

To convert from grams per 0.25 m² to kilograms per hectare (kg/Ha) multiple by 40.

$$58.2 \times 40 = 2328 \text{ kg DM/Ha}$$

rational: we want to express in terms of kgDM/Ha

There are 4 x 0.25 m² in 1m²

There are 10,000 m² in one hectare

There are 1000 grams in a kilogram

Taking data from Table 1 and extending the quadrat data to kg DM/Ha where the dry matter percentage Has been determined to be 20%.

Table 2

Quadrat label (50cm x 50cm)	Nett 'wet' weight grams	Nett 'dry' weight grams (DM%=20) per 0.25m ²	kg DM/Ha
A: Low pasture	119	21.42	952
B: Medium pasture	224	40.32	1792
C: High pasture	402	72.36	3216

Calibrating the GrassMasterPro using the above data.

To carry out a calibration of the GrassMasterPro using the above CWD data, we need to compare the CWD data with the GrassMasterPro's CMR (corrected meter readings).

Then by use of linear regression, we will be able to derive an equation that correctly describes the relationship of CMR readings to CWD data and enter this into the GrassMasterPro

This relationship is highly linear and is in the form of the equation

$$y = mx + c$$

where

y = kgDM/Ha

x = CMR

m = the equation slope

c = the equation intercept of the 'y' axis

ie we will be deriving an equation where

$$\text{dry matter} = m\text{CMR} + c$$

which we can then enter into the GrassMasterPro as the correct equation for that pasture type

(e.g. DM kg/Ha = 0.4800CMR - 300)

Where to find the CMR readings

The CMR readings can be found in downloaded data against each paddock memory allocation reading

GM Paddock #	Name	Area (ha)	Entry date	Soil CMR	Raw air CMR	Sample count	Grass CMR	Grass Type	Dry matter %	Tempe (°C)
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	

The CMR readings can be found in the column headed Grass CMR in the GrassTrack download programme as illustrated above (4th column from right).

Steps required

1) Download paddock data from the GrassMaster Pro using Grasstrack software – view the GrassMaster Pro manual on how to do this.

– in our case, Paddock 1 will have the CMR data for quadrat A, Paddock 2 for quadrat B and Paddock 3 for quadrat C

2)

How to do a linear regression using Microsoft Excel

using the same data example as in table 2 as an example, find and record the CMR readings as in a table 3 below

Table 3

Quadrat label (50cm x 50cm)	Nett 'wet' weight grams	Nett 'dry' weight grams (DM %=20) per 0.25m ²	kg DM/Ha	CMR readings
A: Low pasture	119	21.42	952	3014
B: Medium pasture	224	40.32	1792	3467
C: High pasture	402	72.36	3216	4765

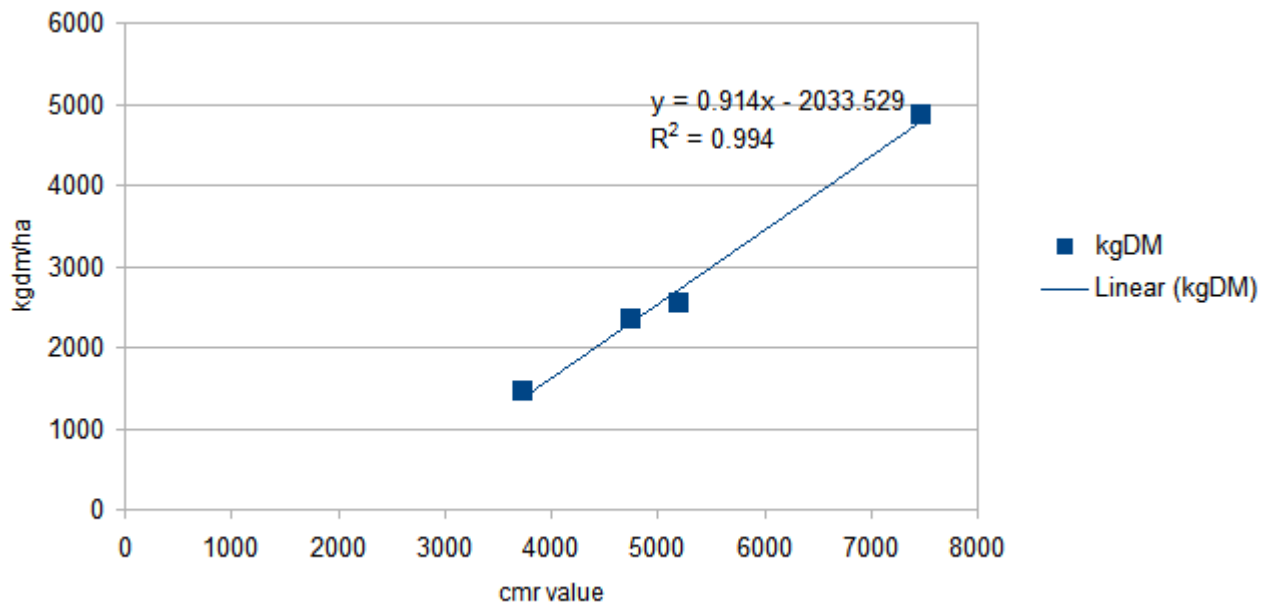
A linear regression can then be readily carried out in an Excel spreadsheet.

Attached with this document is a spreadsheet file with a sample linear regression

You can google 'How to do a linear regression with Excel XXXX where XXXX is your particular year or version of Excel.

Unfortunately different versions tend to use different menu routes to achieve this. The sample spreadsheet file should successfully open in any Excel version from 2003 onwards however. You may have to adjust security options in the Excel programme to facilitate macros permissions for the buttons on the spreadsheet to work.

Below is an example screen shot of the spreadsheet chart that is generated using with four data points (ie four quadrats will have been used) (Excel 2003)



In this instance, linear regression shows a relationship between CMR data and CWD kg DM/ha of

$$y = 0.914x - 2033.529$$

therefore the calibration equation in this example you would enter into the GrassMaster would be

$$DM = 0.914CMR - 2033$$

Again, check the manual on how to do this – pgs 100 - 11