



# **Evaluation of the Weltech PW-2050 dry matter assessment system**

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## Aim

To evaluate the Weltech PW-2050 Weigher for determination of the dry matter content of potatoes.

## Introduction

The British Potato Council, at its Sutton Bridge Experimental Unit (SBEU), was contracted by Weltech International Ltd. (St.Ives, Cambs, PE27 3WS, UK) to evaluate the Weltech PW-2050 Weigher, in comparison with other methods of dry matter determination.

The dry matter (DM) content of potatoes is a key quality attribute and the range of acceptable DM content is usually an aspect of crop specifications. Amongst other things, DM is fundamental to the yield of solids (ie the non-water component of potato) in processing crops and also texture in cooked, ware potatoes. Dry matter content is also used generally as an indicator of bruising risk, with high DM associated with more damage.

Although an important characteristic of potatoes, the actual determination of DM is not usual and most methods estimate DM indirectly, from specific gravity measurements, using empirical conversion factors<sup>1</sup>. Specific gravity is calculated, from the potatoes' weight in air and weight in water, using the following equation:

$$\text{specific gravity} = (\text{weight in air}) \div [(\text{weight in air}) - (\text{weight in water})]$$

The specific gravity of samples is closely related to dry matter (correlation coefficient 0.937<sup>1</sup>), and can be determined using the following formula:

$$\% \text{ Dry Matter}^1 = (24.182 \pm 0.035) + (211.04 \pm 3.33)(\text{SG} - 1.0988)$$

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<sup>1</sup> W.G. Burton, The Potato, 3<sup>rd</sup> edition, Appendix II, Longman Scientific & Technical. ISBN 0-582-46229-0

## Materials and methods

In this evaluation, the dry matter content of 55 samples, from 15 different varieties of potato, was assessed by each of three methods. All three methods estimated dry matter content indirectly by, in effect, weighing tubers in air and re-weighing the same tubers in water. Dry matter was then determined through the conversions detailed above.

### 1. Potato hydrometer

This method requires exactly 3.63kg (8 lbs) of washed tubers for each assessment. The exact weight is obtained by trimming one tuber. The sample, of known weight, is placed in a basket and suspended, using the hydrometer, in water. Samples with low dry matter/specific gravity sink to a lesser extent and the actual dry matter content is obtained by taking a reading from the graduated stem of the hydrometer, at the point where the water level crosses the scale. A Zeal potato hydrometer (G H Zeal Ltd, London, SW19 3UU, UK) model D4500 (17 to 25% dry matter) was used; instructions for this are shown in Appendix 1.

The same 3.63kg sample of tubers used by the hydrometer method, was then used for the other DM determinations.

### 2. 'Grav-O-Tater'

The *Grav-o-tater* is a computer-based system for determination of specific gravity/dry matter (Tai *et al*, 1985)<sup>2</sup>, and is similar in principle to several

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<sup>2</sup> **GRAV-O-TATER**: a computer apparatus for measuring specific gravity  
GCC Tai, GC Misener, ES Allaby, LP McMillan - Am. Potato J, 1985

proprietary systems currently available. The use of a PC allows any weight of tubers to be used and the tuber trimming stage is therefore omitted, with only whole tubers being assessed. This reduces the time taken for carrying out assessments.

With a suitable balance, these systems can also be used to determine DM of small samples and even single tubers.

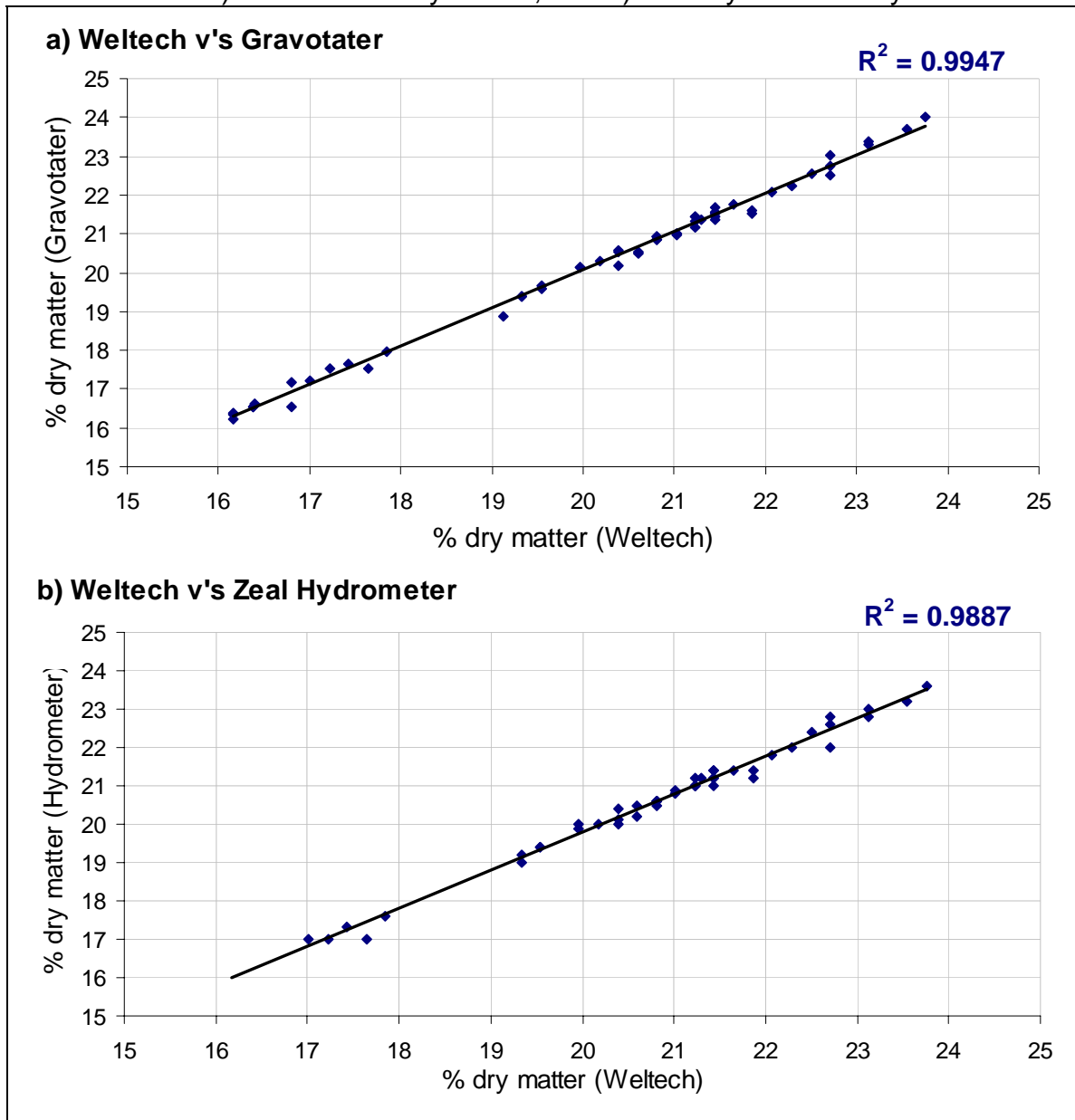
### **3. Weltech PW-2050**

The dry matter content of common samples was also determined using the test system, the Weltech PW-2050 weigher. This system consists of a load-cell and a processor integrated into a small unit from which samples are suspended. As with the *Grav-o-tater* type systems, any weight of tubers can be used.

## **Results**

Raw data for individual samples using the three methods of dry matter determination are shown in Appendix 2. Correlations for dry matter content determined by the Weltech PW-2050 are shown in Figure 1 against dry matter measured using the (a) *Grav-o-tater* and (b) Zeal hydrometer methods. In both cases, a very good correlation existed between the different methods of dry matter determination with  $R^2$  values of 0.9947 and 0.9887 for the *Grav-o-tater* and hydrometer methods respectively.

Figure 1: The relationship between dry matter content determined by Weltech PW-2050 and a) Grav-o-tater dry matter, and b) Zeal Hydrometer dry matter.



Although there was an apparent tendency for the hydrometer system to give slightly lower readings for dry matter, the difference in value for intercept, using the 'line of best fit' was not significantly different from zero for the Weltech and hydrometer methods<sup>3</sup>.

<sup>3</sup> Weltech vs hydrometer correlation: slope = 0.9977, intercept = 0.27, probability of intercept being different to zero = 0.423, ie not significant.  
 Weltech vs *Grav-o-tater* correlation: Slope = 1.007, intercept = 0.21, probability of intercept being different to zero = 0.315, ie not significant.

The data indicate, therefore, that there are no significant differences between the three methods in their estimation of dry matter content.

## **Conclusion**

Very good correlations were obtained between results obtained using the *Weltech PW-2050* and two alternative methods for estimating potato tuber dry matter content and all three methods can be considered to be reliable.

## Appendix 1. Instructions for use of the Zeal potato hydrometer



### **ZEAL POTATO HYDROMETER**

For determining the solid content or percentage of dry matter of potatoes

#### **Specification**

- a) Plastic hydrometer with hook for attaching basket
- b) White paper scale with figures and graduations in black. Calibrated @ 15.6°C
- c) Range: Density of potatoes: 1.065/1.110 g/ml. Percentage dry matter of potatoes 17-25%
- d) Metal counterpoise weight for initial adjustment of instrument
- e) Plastic wired basket

#### **NOTE**

A clean metal or plastic container of at least 360mm diameter x 660mm deep will be required, so that when filled with tap water (temperature approx. 15.6°C), the instrument, with basket attached will float freely. A 50 gallon drum is ideal for this purpose.

#### **Preparatory instructions**

To adjust the Hydrometer before use:

- 1) Attach metal weight by means of its hole, to the hook at the centre of the cross members of the basket.
- 2) Supporting the whole weight of the basket in one hand immerse it fully in the water container. Then with the other hand attach Hydrometer, by means of the hook at bottom, to the loop at centre top of basket and lower apparatus gently until it is floating freely. Take care that the top of the Hydrometer stem does not become submerged in the process.
- 3) When floating freely, in equilibrium, rotate the red plastic cap at top of the Hydrometer stem (clockwise to raise, anti-clockwise to lower), until the Hydrometer floats with the red line at 1.070 on the scale, level with the surface of the water. The Hydrometer is now ready for use.

#### **Instruction for use**

- 1) Select and thoroughly wash a quantity of average size potatoes, equal to a total weight of 8lbs, from the batch to be tested. (It is permissible to cut one potato in half to obtain the correct weight).
- 2) Remove the counterpoise metal weight from the basket and substitute, by very gently placing the selected potatoes in the basket.
- 3) Now follow procedure as detailed in point 2 above (Preparatory instructions).

## Taking a reading

The point at which the water level crosses the graduated scales indicates the density and dry weight of the potatoes and, therefore, their suitability or otherwise for converting into crisps etc.,

## WARNING

- 1) Always remember to use only thoroughly washed potatoes. Should the water become contaminated by particles of earth, inaccurate readings will be obtained. Therefore it is recommended that the water in the container is changed at regular intervals.
- 2) Each Hydrometer should only be used with its matched wire basket. This can be ensured by checking that the serial number on the metal tab attached to the basket corresponds with the serial number on the Hydrometer scale. It is therefore impracticable to supply new component for use with existing parts.
- 3) **It is emphasised again that particular care should be taken to ensure that the top of the Hydrometer stem ( the red cap) is not submerged. If water does get inside the hydrometer it will become unserviceable and should be returned to G H Zeal for repair (all components).**
- 4) **Never** allow the basket, especially when filled with potatoes, to hang unsupported from the hook on the Hydrometer otherwise permanent damage may be caused to the instrument.

## Appendix 2. Raw dry matter data

sample	Grav-o-tater	hydrometer	Weltech	sample	Grav-o-tater	hydrometer	Weltech
Kerrs Pink A	20.5	20.1	20.4	Pentland.Dell B	19.4	19	19.3
Kerrs Pink A	21.3	21.0	21.2	Pentland.Dell C	18.0	17.6	17.9
Kerrs Pink A	20.2	20.0	20.4	Pentland Dell D	17.6	17.3	17.4
Pentland Dell A	22.5	22.0	22.7	Elvira	16.5	nr	16.4
Pentland Dell A	21.0	20.9	21.0	Elvira	16.5	nr	16.4
Pentland Dell A	21.5	21.2	21.9	Elvira	16.6	nr	16.4
Russet Burbank	20.5	20.2	20.6	Lady Rosetta	24.0	23.6	23.8
Russet Burbank	20.6	20.5	20.6	Lady Rosetta	23.7	23.2	23.6
Russet Burbank	20.9	20.5	20.8	Lady Rosetta	23.3	22.8	23.1
Kerrs Pink B	20.9	20.6	20.8	Hermes C	21.5	21.0	21.4
Hermes A	21.8	21.4	21.7	Hermes C	21.7	21.4	21.4
Hermes B	21.4	21.0	21.2	Hermes C	21.6	21.4	21.4
Rembrandt A	21.0	20.8	21.0	Pentland Dell E	17.5	17.0	17.6
Rembrandt A	21.4	21.2	21.4	Pentland Dell F	16.5	nr	16.8
Rembrandt A	20.8	20.6	20.8	Pentland Dell G	18.9	nr	19.1
Remarka	19.7	19.4	19.5	Charlotte	16.2	nr	16.2
Remarka	19.4	19.2	19.3	Charlotte	16.4	nr	16.2
Remarka	19.6	19.4	19.5	Charlotte	16.3	nr	16.2
Courage	22.7	22.6	22.7	Sante	21.4	21.2	21.4
Courage	22.2	22.0	22.3	Sante	21.4	21.2	21.3
Courage	22.1	21.8	22.1	Sante	21.4	21.2	21.2
Lady Olympia	20.3	20.0	20.2	Saturna	23.0	22.8	22.7
Lady Olympia	20.9	20.6	20.8	Saturna	23.4	23.0	23.1
Lady Olympia	20.2	19.9	20.0	Saturna	22.6	22.4	22.5
Carole	17.2	nr	16.8	Mixed varieties 2 <sup>nd</sup> growth	20.1	20.0	20.0
Carole	17.5	17.0	17.2				
Carole	17.2	17.0	17.0				
Rembrandt B	21.2	21.0	21.2				
Rembrandt B	20.6	20.4	20.4				
Rembrandt B	21.6	21.4	21.9				

nr- value outside range of hydrometer.