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Short Communication

New Algorithm for Accurate Conversion of Seed Research Data to Uniform Moisture Level Base

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Seed moisture content plays a vital role in all aspects of seed science and technology research, and trade. Proven relationship exists between seed moisture content and seed maturity, optimum harvest time, longevity in storage, economics in seed drying, etc. It also affects the seed mass (weight) and allied parameters. Grabe [1] describe most of the primary and secondary methods for the measurement of seed moisture. Experiences show that seed moisture content of any crop in experimental plot is never constant at crop maturity or harvest time. More often, its variation was observed in each replication of each experiment. Sometimes, it becomes significant and cannot be ignored. As a result, fresh harvested seed have varying moisture content levels for different experiments or replications, which ultimately affect the seed mass, allied data and parameters, and data analysis.

Grabe [1] also explains the empirical formula, which calculates the seed moisture content on dry mass basis if the seed moisture content on the wet mass basis is given and vice versa. Since the changes in the seed mass is not directly proportional to the changes in the moisture content, the conversion of mass of seeds simply on the basis of the proportionate values of their moisture percentages does not represent the true values. This may lead to serious error in data representation, analysis, interpretation, and also in drawing right conclusion about the experiment(s). Hence there exists a research gap about how to compute the mass of the seed materials at different moisture content levels, if the mass of the same seeds is known at a particular seed moisture content level.

ALGORITHM FORMULATION

We know that seed moisture in per unit (p.u.) basis of any seed sample can be written as:

$$\left(\begin{matrix}\text{Moisture content in}\\ \text{p.u. of dry mass basis}\end{matrix}\right) = \frac{\text{(Moisture content in p.u. of wet mass basis)}}{\text{(1 - Moisture content in p.u. of wet mass basis)}}$$

And

$$\left(\begin{matrix}\text{Moisture content in}\\ \text{p.u. of wet mass basis}\end{matrix}\right) = \frac{\text{(Moisture content in p.u. of dry mass basis)}}{\text{(1 + Moisture content in p.u. of dry mass basis)}}$$

The above two expressions can be mathematically rewritten for mass M_1, whose moisture is X_{dm1} and X_{wm1}

$$X_{dm1} = \frac{X_{wm1}}{1 - X_{wm1}} \quad \ldots\ldots \quad (1)$$

And

$$X_{wm1} = \frac{X_{dm1}}{1 + X_{dm1}} \quad \ldots\ldots \quad (2)$$

Similarly, we can write for seed mass M_2, whose moisture content is X_{dm2} and X_{wm2}

$$X_{dm2} = \frac{X_{wm2}}{1 - X_{wm2}} \quad \ldots\ldots \quad (3)$$

And

$$X_{wm2} = \frac{X_{dm2}}{1 + X_{dm2}} \quad \ldots\ldots \quad (4)$$

But, $M_1 = M_{dm1} + M_{wm1}$ ..... (5)

[Dry mass + Wet mass] of seed sample

Similarly, $M_2 = M_{dm2} + M_{wm2}$ ..... (6)

From Equations (1), (2), (3) and (4); it can be easily established that:-

$$M_{wm1} = \frac{M_{dm1} \cdot X_{wm1}}{1 - X_{wm1}} \quad \ldots\ldots \quad (7)$$

And

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$$M_{wm2} = \frac{M_{dm2} \cdot X_{wm2}}{1 - X_{wm2}} \quad \ldots\ldots\ldots \quad (8)$$

But, the dry mass of the same seed sample at two moisture content level is the same mass:-

Hence,

$$M_{dm1} = M_{dm2} \quad \ldots\ldots\ldots \quad (9)$$

From Equation (5) and (6), it can be written as:

$$\frac{M_2}{M_1} = \frac{M_{dm2} + X_{wm2}}{M_{dm1} + X_{wm1}} \quad \ldots\ldots\ldots \quad (10)$$

With the help of Equations (7), (8) and (9); **Equation (10)** can be simplified as:

$$\frac{M_2}{M_1} = \frac{1 - X_{wm1}}{1 - X_{wm2}} \quad \ldots\ldots\ldots \quad (11)$$

With the help of Equations (1) and (3), Equation (11) can be also expressed as:-

$$\frac{M_2}{M_1} = \frac{1 + X_{dm2}}{1 + X_{dm1}} \quad \ldots\ldots\ldots \quad (12)$$

DISCUSSION

It can be noticed that equation (11) or equation (12) gives a general form of algorithm, which is true for any solid or biological materials including the soil, seeds and non-evaporating liquids. But, the author further notices that a catastrophe occurs in the mathematical expression given vide equation (11), which is not valid for 100% moisture content on wet mass basis. The same is also true for original expression vide equation (1) from where equation (11) has been derived. Hence, the users/ researchers are advised to use equation (2) and equation (12), which are true and valid for all values of the moisture content on dry mass basis. If the moisture content on wet mass basis is not near or around 100 per cent, then either of the mathematical expression given vide equation (11) or equation (12) can be safely employed for all practical purposes.

The further research for finding the region of validity of equation (1) and equation (11) is in progress.

CONCLUSION

This paper gives a new mathematical tool for accurate conversion of the mass of seed or allied experimental data from different moisture content levels to uniform moisture level base. The author hopes that the above-developed mathematical algorithms will be useful in many ways to plant genetic scientists and engineers, and other research workers for accurate presentation, analysis, and interpretation of their research data and findings.

NOTATIONS

M	=	Mass of seed sample at moisture content X_{dm} or X_{wm}
M_{dm}	=	Dry mass of above seed sample of mass M
M_{wm}	=	Wet mass of above seed sample of mass M
X_{dm}	=	Moisture content of the seed sample (in per unit) on dry mass basis
X_{wm}	=	Moisture content of the seed sample (in per unit) on wet mass basis
p.u.	=	Per unit
1, 2	=	Subscript 1 and 2 denote the two separate state (value) of the same seed sample

REFERENCE

1. GRABE, D. F. (1989). Measurement of seed moisture. In 'Seed Moisture.' Edited by Philips C. Stanwood and Miller B. McDonald. Crop Science Society of America, Madison, Wisconsin, USA, pp. 1-115, 1989.