Extended abstract No. 412

COLOUR OF PEATS AS AN INDICATOR OF CHEMICAL AND PHYSICAL PROPERTIES

Dearbháil Ní Chualain[1] & Munoo Prasad[2]

[1]Bord na Móna, Main Street, Newbridge, Co Kildare, Ireland. e-mail: Dearbhail.NiChualain@bnm.ie ph: 00353 45 439520
[2]Compost Research and Advisory, Naas, Co. Kildare, Ireland

SUMMARY

The degree of decomposition of peats is measured by the von Post scale, given by H values, ranging from 1 being totally un-decomposed, to 10, completely decomposed. It is determined by squeezing peat and analysing the escaped water for amongst other things, colour. This is an approximate determination, and it is proposed that the colour of peats be measured by a more accurate method using a colour reader. Minimal sample preparation is needed; peats are dried and ground and colour determined by a proprietary colour reader. The lignin content of the same peat samples was determined, and relationships between colour and lignin content examined. A number of peat samples from H5-H6 as well as H4 sources were analysed, and compared for differences in lignin and colour. The sensitivity of the colour determination was examined through the analysis of peats from one bog, and variation within a bog in relation to colour was also investigated. A strong correlation between peat colour and lignin content was evident. The determination of colour for classification proved to be a more sensitive method than the von Post method and there proved to be significant variation within bogs in relation to colour and therefore lignin. Colour determination may be a fast and cheaper alternative to lignin determination for the evaluation of peat stability.

KEY WORDS: von Post, lignin, colour, stability

INTRODUCTION

The von Post scale (H1-H10), is widely accepted as a measuring tool for the classification of the degree of decomposition of peat. This classification method has the advantages of being simple and quick, and is very suitable as a field method. However, the method is subjective, and with 10 categories, interpretation of results can be complex. In latter years, these 10 categories have been simplified into three distinct decomposition categories; weakly (H1-3), medium (H4-H6) and strongly decomposed (H7-H10), peats (Kivinen, 1980), and in addition have been classified according to their colour (Bunt, 1988), light (H1-3), dark (H4-H6), and black (H7-H10). Indeed colour is often used within the industry as an indicator of the suitability of peat type for certain applications i.e. ‘dark’ peat is used for longer term cropping (Sonneveld and Voogt, 2009). The determination of colour is subjective, and often relies on operator experience for verification rather than a standard laboratory method.

Lignin content has been linked to the stability of peat (Prasad and Maher, 2004) and conversely biodegradability. Therefore, peats with higher lignin contents are more suitable for

longer term cropping due to their relatively lower shrinkage rates, (Aendekerk, 2001) and their ability to maintain optimal substrate porosity for longer (Prasad and O'Shea, 1999). The analytical determination of lignin within a peat sample is complex, and as a result, relatively expensive.

In this paper, a standardised preparation of samples is utilised and a colour meter is used to determine peat colour. In addition, the correlation between peat colour and lignin content is explored, allowing for a reliable and rapid determination of lignin, and hence peat stability. The variation within one von Post classification and within one bog is also investigated using colour. This simple determination may enable the final user to choose the correct peat type for each cropping system.

MATERIALS AND METHODS

Previous work has shown a link between the lignin content of European peat samples and their colour (Prasad and Maher, 2008). This link was further investigated with a larger data set, using 68 peat samples from 8 European countries (Belarus 1, Germany 6, Estonia 8, Lithuania 6, Finland 3, Latvia 9, Sweden 3 and Ireland 32 samples). These samples consisting of unprocessed (off the bog) peat were dried at 105 ^{o}C using the standard European method (European Committee for Standardization (CEN), 2007). Samples were then ground to <2mm using a laboratory grinder (Kinematica Polymix PX-MFC 90D/S, Luzernerstrasse 147a CH-6014 Lucerne) and returned to the oven until analysed. The ground samples were then placed into a shallow plastic dish (approx 2 cm diameter), and tamped to ensure an even surface. A Konica-Minolta C-10 colour reader (Konica-Minolta Sensing Inc, Japan) was then used for the determination of colour. This reading was repeated in triplicate. The samples were further analysed for lignin (Van Soest, 1963).

The variation in colour (and hence lignin content) within one Von Post category was also investigated. Four Irish bogs were sampled as per Table 1 below, and analysed for colour using the method described above. By choosing Irish bogs which are classified into the same category using the Von Post scale (H5-H6), the relative sensitivity of the colour determination was established. From the four Irish bogs investigated, a total of 167 samples were analysed.

The variation within one bog was investigated. Colour data from individual peat piles (windrows) was analysed for variability across the windrow. Four H5-H6 bogs were investigated, and 24 peat windrows comprising of 167 samples were analysed. The sampling of each bog is again outlined in Table 1. The correlation between colour and lignin, and colour variation within samples was established using the statistical package Minitab 16 (Minitab, U.K.).

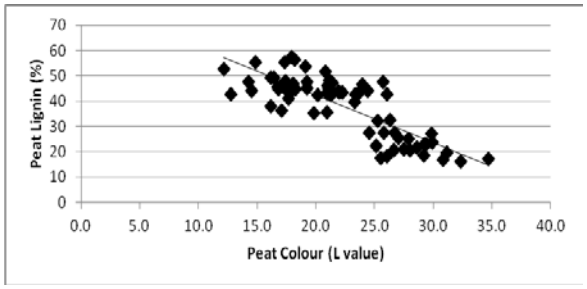
Table 1 Sample reference for colour analysis across four H5-H6 bogs, and within bogs

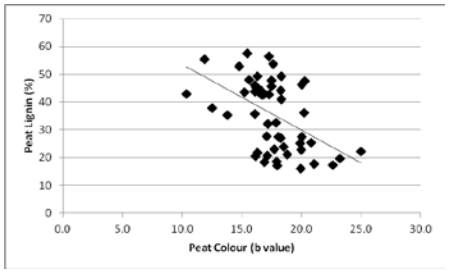
Source	No. of piles/windrows (24)	Number of samples analysed per bog (167)
Irish Bog 1	4	40
Irish Bog 2	8	53
Irish Bog 3	5	25
Irish Bog 4	7	49

RESULTS

Readings from the colour reader are given in the Hunter colour scale of L,A and B, where L measures the range from black to white (with readings of 0 to 100 respectively), The A values read colour from the green to red parts of the spectrum, and B values monitor the blue to yellow area of the spectrum. A highly significant correlation (Pearson correlation of 0.82) was found to exist between peat lignin content and the L reading (Figure 1), and a lesser correlation but none the less significant, was evident between lignin and the b value (Figure 1) (Pearson correlation of 0.82). The weakest correlation existed between the 'A' value and lignin (data not shown).

Figure 1. Correlation between L value and lignin and b value and lignin of peat samples from 8 European countries (n=69)





$p<0.0001$ Pearson correlation coefficient 0.82 ($r^2 = 0.67$) $p<0.0001$ Pearson correlation coefficient 0.49 (r^2 0.25)

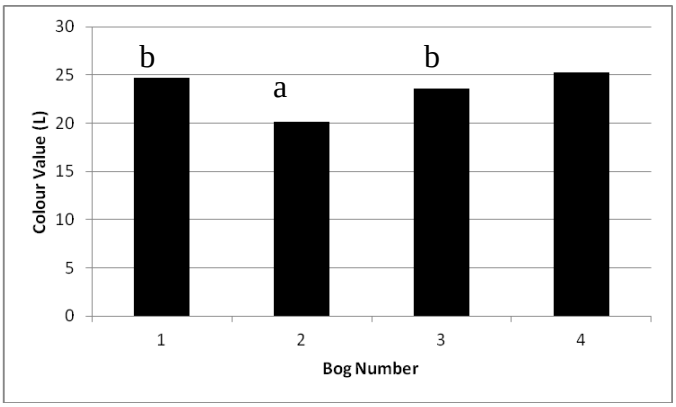
The second part of the study investigated the sensitivity of the colour measurements, by analysing peat samples from within one category of the Von Post scale (H5-H6). The aim of this section was to establish whether a significant difference in colour (extrapolated to lignin) existed between peats from this single category. These results are presented in Figure 2. Significant differences in colour are observed between samples from bog 2 and the other two bogs (LSD 5% 1.12), showing that peat samples from bog 2 were significantly darker in colour than the other two bogs.

When investigating the colour differences from samples within these H5-H6 bogs, windrows from the four bogs outlined in Table 1 were analysed individually. Significant differences in colour across single windrows were found in three of the four bogs analysed. Highly significant differences ($p<0.001$) in colour were found within windrows from bogs 3,4 and 5. One bog was shown not to have significant differences in colour across the windrows; Bog 1 ($p=0.855$ data is not shown).

DISCUSSION AND CONCLUSION

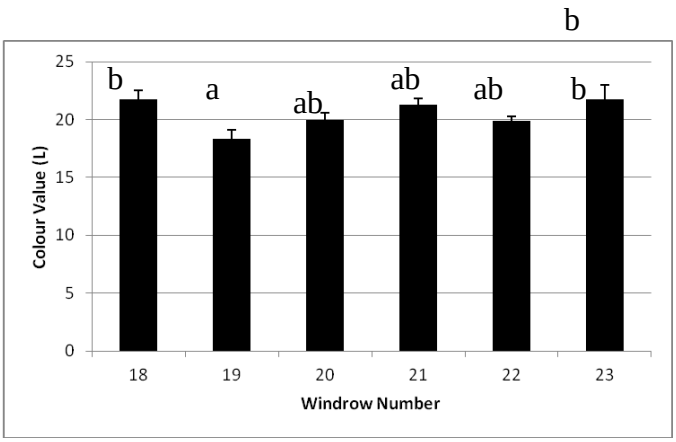
Since 'L' is a scale of 'darkness' and 'B' of 'yellowness', the greater the L value, the lighter the peat, and the higher the B value the yellower the peat. Therefore darker peats were observed to have lower 'L' and lower 'B' values, and correspondingly higher lignin contents than lighter peats. This study further endorsed earlier work showing that the colour of peat is a quick, reliable estimate of the lignin content of peat, and is suitable as a laboratory method for the indication of peat stability and therefore decomposition category. The variation in the

colour of peat samples from within one category of the von Post scale was shown to be significant, indicating that the measurement of colour is a more sensitive indicator of peat decomposition (linked to lignin) content than the von Post scale. The variability within bogs through individual peat windrows has also been established through the use of colour measurement, and was shown to be highly significant, showing that considerable variation may exist not only from bog to bog, but even within individual peat windrows. In measuring within one category of the von Post scale, the measuring of colour was sensitive enough to distinguish between peats within one individual Von Post category (H5-H6).



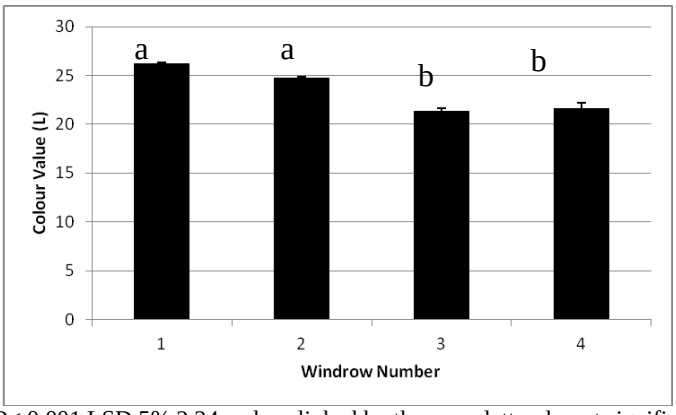
p<0.05 LSD 5% 1.12 values linked by the same letter do not significanlty differ

Figure 2. Colour readings (L values) of peat samples taken from four Irish bogs showing significant differences between four H5-H6 bogs (n=92)



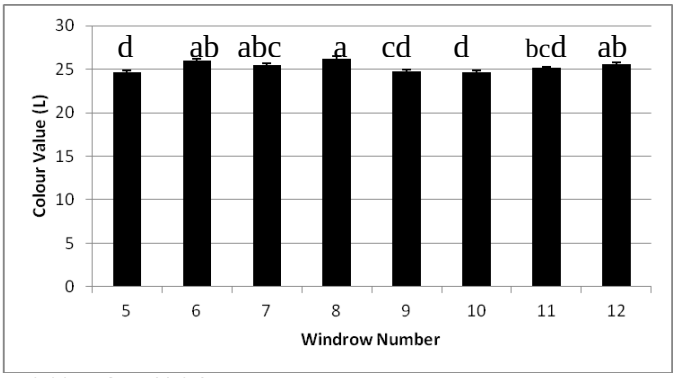
P< 0.05 LSD 5% 3.23 values linked by the same letter do not significanlty differ

Figure 3.Colour readings (L values) of peat samples taken from Bog 2, showing significant differences in colour between windrows



P< 0.001 LSD 5% 2.24 values linked by the same letter do not significanlty differ

Figure 4. Colour readings (L values) of peat samples taken from Bog 3, showing significant differences in colour between windrows



P<0.001 LSD 5% 0.81

Figure 5. Colour readings (L values) of peat samples taken from Bog 4, showing significant differences in colour between windrows

ACKNOWLEDGEMENTS

Sincere thanks to Colman Hynes for the concise, accurate and painstaking measurement of multiple samples, and other technical expertise. Thanks also to Dr. Bill Carlile and Michael Gaffney at Teagasc, Dublin for invaluable advice.

REFERENCES

AENDEKERK, T. (2001) Decomposition of peat substrates in relation to physical properties and growth of Skimmia. *Acta Horticulturae,* 548**,** 261-268.

BUNT, A. C. (1988) *Media and Mixes for Container-Grown Plants,* London, Unwin Hyman.

EUROPEAN COMMITTEE FOR STANDARDIZATION (CEN) (2007) Soil improvers and growing media - Sample preparation for chemical and physical tests, determination of dry matter content, moisture content and laboratory compacted bulk density.

KIVINEN, E. (1980) Proposal of General Classification of Virgin Peat. *Proceedings of the 6th International Peat Congress* Duluth.

PRASAD, M. & MAHER, M. (2004) Stability of peat alternatives and use of moderately decomposed peat as a structure builder in growing media. *Acta Horticulturae,* 648**,** 145-151.

PRASAD, M. & MAHER, M. J. (2008) Moderately decomposed peat as a structure builder for younger peats in growing media. *Acta Hort. (ISHS),* 779**,** 185-190.

PRASAD, M. & O'SHEA, J. (1999) Relative Breakdown of Peat and non-peat growing media. *ISHS Acta Horticulturae : International Symposium on Growing Media and Hydroponics,* 481.

SONNEVELD, C. & VOOGT, W. (2009) *Plant Nutrition of Greenhouse Crops,* Springer.

VAN SOEST, P. J. (1963) Use of detergents in the analysis of fibrous feeds, II. A rapid method for the determination of fiber and lignin. *Journal of the A.O.A.C* 46**,** 829-835.