The Visual Evaluation of Soil Structure (VESS) in Tropical Soils: How and When to Sample

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Introduction

Ten-years on from the publication of the original version of the Visual Evaluation of Soil Structure (VESS) method by Ball et al. (2007), the VESS method is now the most frequently used visual method for the assessment of soil structural quality in Brazil. The original method was adapted and updated from the Peerlkamp test, with improvements and the most up to date version of the associated decision chart published by Guimarães et al. (2011).

Since it was introduced to Brazil VESS has been shown to work well on tropical soils, with VESS scores shown to correlate well with a number of soil quality indicators, such as soil bulk density, macro and microporosity, least limiting water range, tensile strength and weighted mean diameter, as well as with macrofauna indicators. As the method has been disseminated through Brazil it has been tested under a greater variety of soil types, cropping systems and environments, which have lead to VESS being exposed to a greater number of challenges. Despite VESS correlating well with quantitative soil quality indicators in tropical soils, the new exposure has resulted in a number of questions being put forward in relation to how and when to sample. There are many large-scale farms in Brazil and it is of interest to know the adequate number of VESS samples required to accurately and efficiently characterise a field. Further to this, the moisture content of the soil during the VESS evaluation is important, as it affects how the aggregate responds to the aggregate hand test, meaning that aggregates can appear to be more, or less, compacted than they actually are. Field observation have indicated that the standard two days after a rainfall event commonly used for optimal sampling at field capacity may not be accurate under certain conditions in Brazil.

The objective of this work was to improve VESS sampling by indicating the preferred sampling number, pattern and time.

Material and methods

VESS sampling number and pattern

To assess the preferred sample number and collection pattern for VESS a field located on a farm in Chopinzinho in Parana, Brazil, containing soybean in the summer and ryegrass for fodder in the winter was sampled. The sampling area was 100 m x 100 m, with samples taken at 20 m intervals, giving a total of 36 sampling points in a grid. At each sampling point a VESS sample was performed. VESS is an integrated semi-quantitative method for the assessment of soil structural quality involving the manual breakdown of soil aggregates along their fracture lines, identification of layers of contrasting structure, measurement of layer thickness and the assignment of a score by comparing the structure of the sample with the VESS chart. The chart contains descriptions and pictures of each proposed soil structure quality to guide the user in their assessment of the soil using a variety of soil characteristics including aggregate strength, shape and porosity, alongside colour and smell, to assign the soil a score that indicates the structural quality of the soil. Analysis of the variability of the VESS score and mapping of the spatial distribution allowed the calculation of the number of
samples needed to characterise a field and also allowed the comparison between the full sampling grid and “Z”, “W” and transect sampling patterns.

Effect of soil moisture on VESS
Seventy aggregates from Sq 4 soil layers of an Oxisol (80% clay) were collected after a rainfall event from an oat field in Pato Branco, Brazil. Every 24 hrs, ten of the aggregates were assessed in the laboratory using the VESS aggregate hand test during the aggregate drying cycle to identify the response of the aggregate when submitted to the hand test. In conjunction with the hand test, samples for gravimetric water content were taken each day.

Results and Discussion
The results showed that there was no difference between the mean Sq score acquired for the full sampling grid and those found for the “Z”, “W” and transect sampling patterns. This indicates that the pattern with the least amount of sampling effort would be the most efficient for characterising the studied area. It was also found that the minimum number of samples needed to accurately characterise the field using VESS would be one per hectare. Although, for statistical reasons, we recommend that at least three samples be taken per hectare (Guimarães et al., 2017).

It was found that the best time to sample VESS was 3-6 days after a rainfall event. If taken earlier than 3 days after, then the aggregates do not break, instead they deform under pressure during the hand test. While six days after the rainfall event the aggregates become too hard to perform aspects of the method, such as the progressive aggregate breakdown (last column of the VESS chart – Guimarães et al., 2011).

Conclusion
These results indicate that three VESS samples were needed to accurately characterise the 1 ha area sampled in the study and that the sampling pattern did not affect mean Sq score. Further to this, it was found that sampling at field capacity could mean that the soil is too wet for performing VESS under some conditions in Brazil, which could result in evaluation errors, especially with inexperienced users. It is proposed that the period 3-6 days after a rainfall event may be best for sampling VESS in Brazil.

References