Albrecht and the Basic Cation Saturation Ratios concept

As an experienced Soil Scientist with a focus on soils and crop nutrition, I feel that a little attention ought to be brought to Albrecht and the Soil Basic Cation Saturation Ratios concept (BCSR). I was recently asked for my views on it in a forum thread, where it frequently keeps cropping up, so I'd like to try to separate out some entanglements of truth and myth presented by some proponents of this.

Commonly known as Albrecht BCSR, it has attained a popular and rapidly growing following with farmers. For those who might be unfamiliar with the concept, stripping everything else away, the key central claim within the BCSR approach that differentiates it from accepted soil science is the assertion that there are strict confines of 'ideal' ratios for the major Cations (Ca, Mg & K) as a percentage of Base Saturation for total Cation Exchange Capacity (CEC) i.e. cationic balancing, particularly for Ca:Mg.

According to the BCSR concept, optimal soil structure and plant growth will be achieved only when the soil's exchangeable Ca, Mg, and K concentrations are very close to a 'golden ratio' of 65% Ca, 10% Mg, and 5% K.

This idea was based originally on limited research on soils and crops in New Jersey (Bear) and Missouri (Albrecht) in the 1930's and 1940's and is now widely discredited, having been shown to have no bearing on crop performance or soil structure within very wide parameters.

Undoubtedly, the presence of significant quantities of Ca, Mg and K in the soil is important to adequate crop growth. As we know, availability for many nutrients is affected by pH and, yes, Ca at higher pH is increasingly involved in sorbing and reacting with soil P, for example, into a range of Ca-P minerals, making P increasingly unavailable. However, below pH 6.5 other minerals – mainly Al, Fe, Mn and silicates - are predominantly responsible for reactions with P making it increasingly unavailable as pH decreases. pH is the key determinant, not BCSR. BCSR is also based on the notion that CEC is a fixed quantity for any given soil, something we know not to be true.

This brief article is not the place for a detailed discourse, however, there are a large number of scientific papers devoted to the refutation of this concept, particularly in recent times, such as the detailed reviews by Kopittke & Menzies (Soil Sci. Soc. Am. J. 71:259–265, 2007) or Simson et al. (Commun. Soil Sci. and Plant Anal. 10:153-162 1979), and I can probably do no better than quote from Dr D.C. Edmeades addressing the 26th Annual Conference of The Grassland Society in 2011 in his paper "Pseudo-science: a threat to agriculture?":

"Similarly, farmers ... are being told by pseudo-scientists that the 'old' method of soil testing and fertiliser advice, which is based on scientific evidence, is out of-date and that a theory, suppressed for years by the establishment, has been rediscovered – Professor Albrecht's Base Cation Ratio Theory is now in vogue. Once again this is pseudo-science in action for it is known that the Ratio Theory is, not only technically flawed, but results in grossly incorrect fertiliser advice and hence inefficient agricultural production."

Indeed, McLean, who worked with Albrecht in Missouri during the 1940s, stated that, on the whole, "there is no 'ideal' basic cation saturation ratio or range" (Eckert and McLean, 1981), and that "emphasis should be placed on providing sufficient, but not excessive levels of each basic cation rather than attempting to attain a favorable basic cation saturation ratio which evidently does not exist" (McLean et al., 1983).

While it is undoubtedly true that soil K and Mg levels in the soil solution are important to crop nutrition one to the other it is not because of any cation exchange effect in the soil. Rather it is because it has been established that the two ions compete with each other at the root surface and inside the root for uptake and distribution into the plant – in other words a cellular membrane antagonism. For this reason only, K:Mg levels in soil do need to be understood and adjustments made to fertiliser applications – usually Magnesium – for specific crops. It is perhaps because of this antagonism that crop responses are sometimes recorded in extremis and erroneous claims made about the success of BCSR.

Why is all this important?

The BCSR concept has been widely discredited for many years outside of its origins back in the late 1940's. Nevertheless, my concern is for the growing level of hard-selling that's going on to farmers both in the UK and overseas who are simply looking for ways to improve their soils, soil structure and nutritional status. Given the very hard times many of them are facing, it is of concern that they are being persuaded to spend potentially large amounts of money, effort and time on this.

Farmers are being sold a whole soil health/nutrition philosophy based on Albrecht BCSR and derived acolyte systems and encouraged to try to achieve the 'golden ratio' by purchasing and large applying quantities of fertilisers containing these elements.

Unfortunately the conflation of the core Albrecht philosophy along with some accepted science makes it difficult to pick out what is science from pseudo-science. Obviously, I'm not accusing anyone of doing this deliberately.

The data do not support the claims of the BCSR, and continued promotion of the BCSR will result in further inefficient use of resources in agriculture and horticulture, distraction from genuine nutrition issues and the waste of significant time and money by farmers.

As professional soil scientists I feel that, as they have done in South Africa and New Zealand, it is our role to become much more vocal in the popular farming press about this and other pseudo-scientific practices that our being peddled as proven soil science.

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