By Dr Steve Oosthuyse

Improving yield AND QUALITY

Dr Steve Oosthuyse of HortResearch SA has developed a method of improving crop stand yields, as well as the quality of the produce. The method is entirely empirical, not relying on assumptions. In essence, data is collected from a stand and analysed. Multivariate analysis techniques are used in view of the nature of the problem at hand.

Manipulation of variables

Crop stands or regions can only be improved by manipulating variables under the control of growers. Water availability is the primary factor. Water application and its distribution are in nature's hands, where growers cultivate dry land. This is the case for most soya bean growers in South Africa.

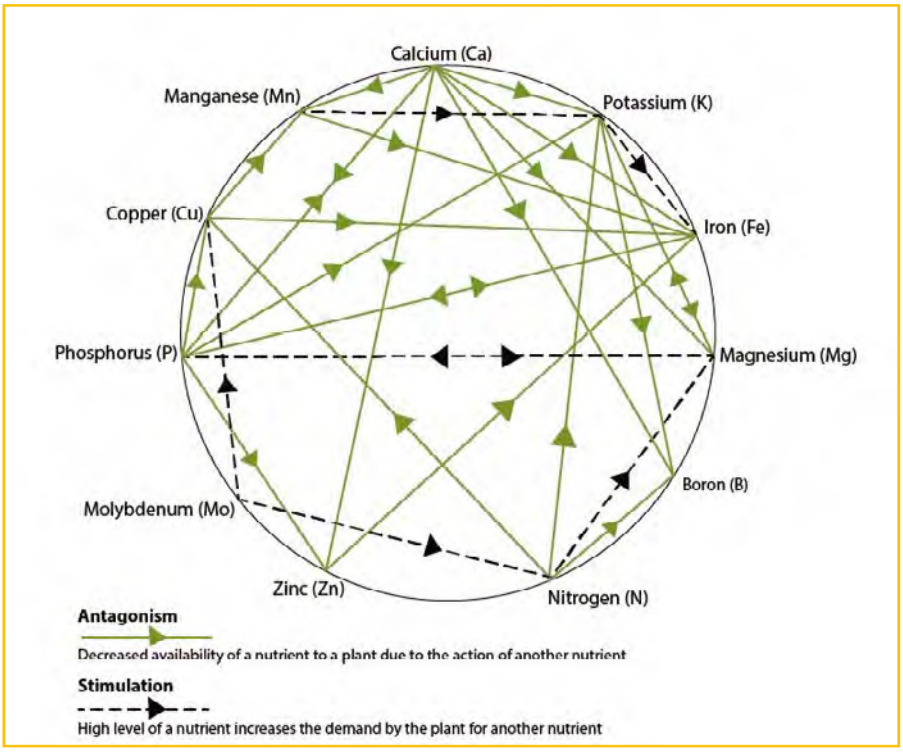
Soil condition and fertility is also of prime importance. When considering fertility, the mineral nutrient balance of the soil is important. Invariably, excess and deficiency exist initially or develop over time, these imbalances being counter-productive.

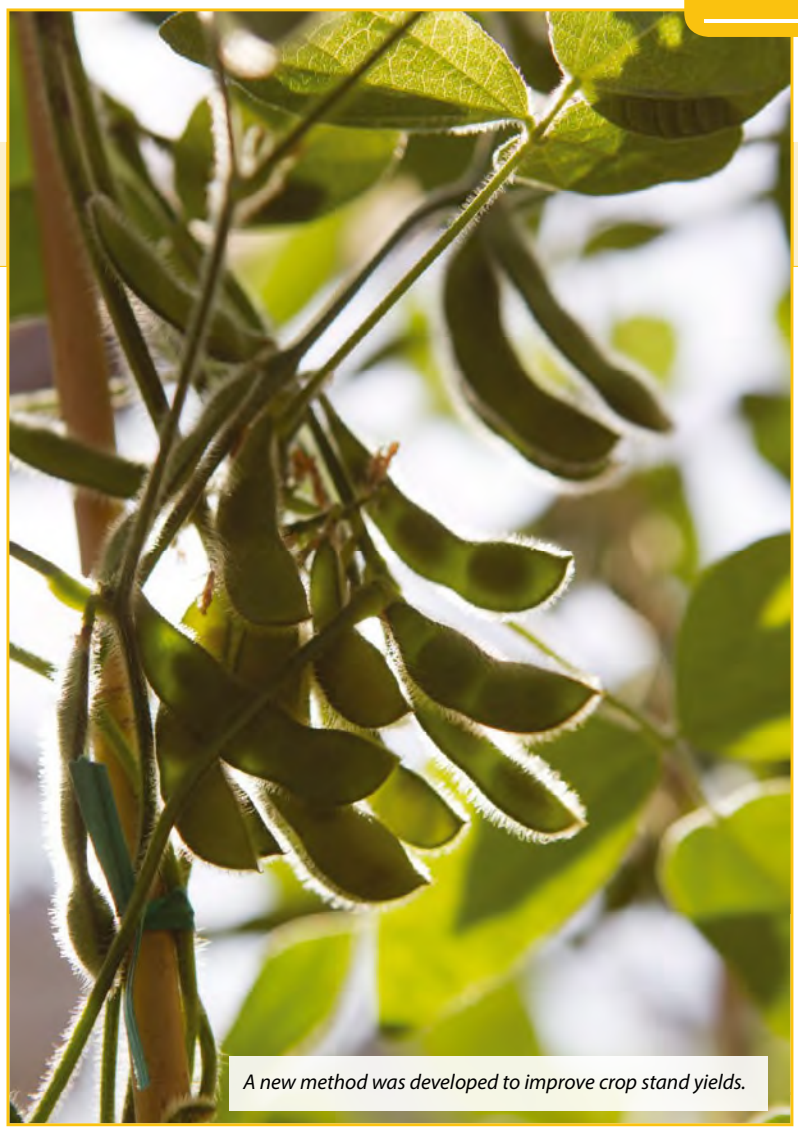
Soil condition relates more to structure, drainage, organic matter content, pH and the content clay, silt and sand. Condition also relates to sodium and chloride levels, and the types of clay minerals present, whether 2:1 or 1:1 lattice clays. The method directly identifies imbalances limiting productivity, whether they are in excess or are deficient. However, it is only those factors which growers can influence that are relevant.

When considering the mineral nutrient status of the soil, interactions exist in respect of plant uptake, both in the sense of synergism and antagonism. Most well-known is the antagonistic effect of soil calcium excess on root uptake of magnesium and potassium, the antagonism of excess potassium on the uptake of calcium and magnesium, and the antagonism of excess magnesium on the uptake of calcium and potassium. Interactions are far more complex in reality. Mulder's chart (*Figure 1*) documents certain of the well-known interactions between nutrients.

The initiator of the remedial measures technique, Dr Steve Oosthuyse of HortResearch SA.

Figure 1: Mulder's Chart documenting certain interactions existing between nutrients in the soil, in respect of root uptake capacity.





A new method was developed to improve crop stand yields.

Besides the interactions between mineral nutrients in respect of uptake, organic matter content, clay level, clay type, microbial activity and soil pH, a myriad of other factors influence and further compound the issue. When considering the soil, it might be concluded that factors affecting growth – either positively or negatively – are multiple, interactive and impossible to clearly define. Furthermore, to quantify these interactions is not objectively possible.

Simple premises

Field agronomists have no choice but to rely on simple premises, and then to ascertain whether actions taken were advisable or unwise in evaluating responses subsequently noted, and to then make adjustments accordingly. In essence, recommendations of nutritional practices to follow can often be effective, but can generally be non-ideal, due to failure to truly account for occurring interactions and the degrees to which interactions exist.

The empirical approach clearly elucidates actions favouring or disfavouring yield and quality.

In discerning the problem at hand, we are left with no alternative but to quantify what we can and determine what relationship exists with that which is financially significant, namely yield and quality. We can further endeavour to grasp the relationship by utilising our current knowledge. Irrespective of this, the empirical approach clearly elucidates actions favouring or disfavouring yield and quality. In essence, this is the Remedial Measures Technique, as documented by Oosthuyse in 1999 and 2009.

Statistical methods

Biometricians, i.e. statisticians developing and using statistical techniques directed at biological systems, have long mastered methods isolating causes for effects, whether direct or indirect. All statistical methods rely on replication, the unbundling of correlation and the provision of probabilities. The need of a concerned grower is a straightforward recommendation. His concern is accuracy, and not a detailed understanding of the analytical methods involved.

In carrying out the procedure of sampling plots, at least 20 are isolated per site or location, and data of an independent and dependent nature is obtained from each site. An obvious prerequisite is representative sample plot distribution. The more variables that can be quantified the better, even if some cannot be controlled or altered by the grower.

In the case of soya beans, obvious dependent variables are plot yield, oil and protein content. Independent variables can be those generally made explicit in a soil analysis. Soil pH, orthophosphate concentrations, boron and molybdenum concentrations, exchangeable nutrient cation saturations, clay contents, organic matter contents and nitrate and ammonium concentrations all suffice as independent variables.

The method is entirely objective, the input data imparting remedial measures without the processing agent having to make assumptions. The technique can be applied to a farm section, a farm or an entire region. The emphasis is on the accuracy and representativeness of the input data. One approach is to analyse a region, then to zone in on specific farms, and then sections of individual farms.

Questions concerning the technique or its implementation can be directed to Dr Steve Oosthuyse at hortres@pixie.co.za. Visit *www.hortresearch.co.za* for more information.