INTERPRETATION CRITERIA FOR HISTOGRAM REPORTS

Most soil testing laboratories nowadays have a reporting option which shows the result as a histogram (or bar graph). This enables a quick assessment to be made, i.e. whether the result is low, medium or high.

One would imagine defining the "normal range" criteria would be reasonably straightforward, and could be taken from the literature. This is not always the case, and this note outlines the problems we have faced over the years setting "normal ranges" for our histogram reports.

What is the "medium range" ?

Generally, it is a desirable result if the analysis result falls into the middle range of the histogram. There is no likelihood of deficiency, nor an excess of that particular element. But what to call that range is not as simple as one might imagine. Options we considered were:

i. **Medium Range**. This name suggests an optimum, non-limiting range. It is quite vague and ill-defined.

ii. **Normal Range**. Slightly more descriptive than "Medium Range" but still ambiguous. Normal in terms of what levels are usually found?This may be the levels typically found, but could still be low or high in terms of the plant's requirements.

iii. **Optimum Range**. More descriptive again, but still ambiguous. Optimum from what perspective? Plant requirements? Grazing animal requirements? Economically optimum?

iv. **Target Range**. This implies something to aim or strive for, but is often a very narrow range, whereas nature tends to have a wide tolerance margin.

v. **Agronomic Optimum**. A subset of the Optimum Range, and one that has been recognised as being particularly relevant. It is reasonably unambiguous, although the issue of whether it applies to the plant's or grazing animal's needs may still arise.

vi. **Economic Optimum**. This option is mentioned, but is not really viable, as the levels would be constantly changing, depending on the returns from agricultural produce. From the farmer's or grower's point of view, it would be highly relevant.

"Agronomic Optimum"?

Most of our clients are wanting to grow healthy, vigorous crops, and to assess the results in terms of the agronomic optimum makes good sense. This heading is quite descriptive, and states most clearly what the criteria are based on.

This approach does have two drawbacks, however, which are, it takes no account of what is normally found, or the economic implications of adjusting the nutrient levels.

Consider manganese levels in pasture. While the plant may require only 20 ppm, and the animal 40 ppm, many pastures contain 50 -100 ppm of this element. Do we want to be sending the message that these farms have high manganese status, when manganese at these levels has not been identified as being indicative of agronomic problems? This is an instance of where some account should also be made of the normally found levels.

Another example would be optimum levels for pasture soils. The agronomic optimums for growing pasture should be the same irrespective of whether the pasture is being grown for sheep or for dairy farming. Yet the lower economic returns of sheep farming compared to dairy farming mean that generally lower nutrient levels are proposed for soils from sheep farms. That is, there is some allowance for economic optimum being made.

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Adoption of the term “Medium Range”

In setting the levels, we have always kept in mind “who is going to use this data and for what purpose?” In most instances, the farmer or his consultant want the laboratory report to tell him whether a nutrient is at an adequate/normal/ optimal/typical level, or if it is low/deficient/high/toxic/excessive. With the end-user in mind, we have adopted a certain degree of pragmatism when defining the levels. Hill Laboratories decided to adopt the term “Medium Range”, because of it’s non-descriptive nature. It did not limit us as to how we set the reference ranges, and allowed us freedom to choose the most appropriate level for it’s predominant use.

The concept of “agronomic optimums” is the main basis for setting the medium levels at Hill Laboratories, but where appropriate, account is also taken of levels typically found, and also economic realities. Where the issue of plant vs grazing animal requirements arises, whichever was the higher was generally adopted, e.g. cobalt (animal), selenium (animal), potassium (plant) in mixed herbage.

The Low and High Ranges of the Histogram

As well as defining the Medium Range, two other levels are included in our database to specify the low and the high ranges as well. Four levels (L1 to L4) are entered into our database, and they define the lower and upper boundaries of the three zones Low, Medium and High. The levels are set so the following interpretation applies:

Bar Graph Position	Interpretation
Far LHS of Low Range (L1)	Deficient, seriously low. Is of concern
Low Range (L1 - L2)	Lower than normally found. May be a concern
Medium Range (L2 - L3)	Optimal. Non-limiting production
High Range (L3 - L4)	Higher than normally found. May be a concern
Far RHS of High Range (L4)	Excessive, seriously high. Should be of concern

Where do the values we use come from?

The first preference is given to research data generated in New Zealand, based on field trials. Such data is available for only a limited number of crops, e.g. pasture, kiwifruit, maize. In the absence of local information, overseas data has also been extensively used, particularly for plant tissue levels. Such data is often sourced from reliable publications, or sometimes from interpretive criteria used by other organisations.

Recently, we have started to utilise the data that has been accumulated at our own laboratory. While this data does not have any accompanying information regarding plant yield and/or vigour, it has been collected from a variety of locations, over several years, and may comprise of several thousand sets of results. This is very valuable information, especially since it has been generated under NZ growing conditions.

This data is being used with caution, and only after consultation with experienced consultants and scientists. Where there are known or suspected deficiencies or toxicities, this information heavily influences the setting of the four interpretive levels.

If there is no known or suspected problems for an element in the NZ crop (e.g. sulphur in avocado crops), then the medium range will default to the zone where two-thirds of the results fall. The lowest sextile (sixth) will then fall into the low range, and the highest sextile into the high range. This approach does ensure that not all results will fall into the medium range, thereby allowing the end-user to see how their results compare to other NZ results.

In reviewing this data, we have found that some medium ranges defined from overseas data have been too broad – often the NZ results are tightly grouped at one extreme of the medium range. In such instances, we will modify the interpretive levels to better reflect the NZ situation.

The data from our database is of most use in defining the medium Range, i.e. L2 and L3. L1 (the deficiency level) and L4 (the excessive/toxic level) cannot be derived from the database, and must be sourced from the literature, or estimated from published values for similar crops.

Conclusion

As much as we would like to have a clearly defined approach, a certain amount of pragmatism and common sense is involved when setting the interpretive levels. We utilise information from a variety of sources, and when defining the four levels, we use the interpretation table above as our principle guide.

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