MICRONUTRIENT DEFICIENCY

FROM DIAGNOSIS to remedial strategy

Micronutrient deficiency can be highly detrimental to crops. Fertilising products are therefore sometimes necessary, and the use of precise diagnostic tools helps to integrate them accurately into a manuring plan.

Micronutrient deficiencies are specific to each crop. For example, maize is particularly prone to zinc (see below) and manganese deficiency.

Micronutrients, also known as minor or trace elements, are nutrients found in small amounts in the soil and absorbed in small amounts by plants. Several studies have shown how important they are for plant function, from cell breathing (iron, copper) to photosynthesis (iron, copper and manganese), protein (iron, zinc) and hormone (zinc, boron) synthesis, and nitrogen uptake (iron, copper molybdenum).

In arable farming, iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), boron (B) and molybdenum (Mo) deficiency can be a problem. Cereals require particularly high levels of copper and manganese, and maize of zinc and manganese.

An assessment is essential

The Law of Limiting Factors, established by Liebig in 1850, is one of the most important agronomic principles.

This theory about plants' mineral intake states that the level of production of a crop is determined by the most limiting nutrient. In other words, the yield is limited by the nutrient deficiency that occurs first, regardless of the level of fertilisation from the other nutrients.

In other words, the yield is limited by the nutrient deficiency that occurs first, regardless of the level of fertilisation from the other nutrients. Micronutrients

are no exception to this rule. Therefore trace elements should not be applied automatically, but should be considered after assessing limiting factors.

The assessment of micronutrient deficiency often begins with a visual observation of characteristic symptoms. This basic diagnosis must follow a well-defined approach: start by examining the shape of the affected areas in the parcel, then the general condition of the plant and finally the foliar symptoms. Tissue analysis will later confirm, or disprove, this visual diagnosis.
Not all deficiencies produce visual symptoms. In this case, tissue analysis is the only way of producing a diagnosis. It provides an annual assessment of manganese and zinc nutrition. Soil analysis assesses the availability of copper, zinc, boron and molybdenum, and should be carried out regularly in soils presenting a risk of deficiency.

Distinguishing true deficiency from induced deficiency

When a trace element deficiency is caused by an insufficient level of that nutrient, it is called true deficiency. In that case the only possible corrective action is to supplement the soil supply by inputting this micronutrient.
However, many deficiencies are encountered in situations where the soil content level is sufficient. Indeed, the phyto-availability of trace elements can be altered by environmental factors: an imbalance between nutrients (e.g. between phosphorus and zinc, or between phosphorus and copper), or the physical and chemical properties of the soil like a high pH affecting manganese availability, or the organic matter content affecting copper's and manganese's. It is also altered by the structure of the soil (a loose, fluffy soil has an effect on manganese availability, and compacted soil affects zinc), and by weather conditions (for example, low temperatures induce zinc deficiency symptoms in maize).
This is referred to as an induced deficiency. In this case, the deficiency should be corrected, but also its environmental cause, if possible. For example, we should avoid creating a loose seedbed if there is a risk of manganese deficiency, which is exacerbated by excessive aeration, or change the lime input strategy in cases of manganese deficiency induced by over-liming.

Which remedial strategy?

Once an assessment has been made, several remedial strategies are often possible. In cases of severe deficiency, a foliar application is recommended for rapid correction. Some cases may require several applications. In contexts where deficiency is a recurring issue, soil inputs may be considered. The recommended rates will then cover the needs for several years and will only be reapplied after a soil analysis.
Don't invest randomly. Trace element "cocktails" should be avoided, especially copper-zinc-manganese mixtures. It is much better to target the deficient trace element. In case of double deficiency, it is preferable to correct one by a soil input, and the other by a foliar application.
There is little difference between products, especially foliar ones, when used at comparable rates. Below the recommended rates, the efficacy of the products is proportional to the rate applied, regardless of the product used. Finally, on mixed farms with both crops and livestock, it is important to take into account the trace elements input derived from organic waste products (see article on "Organic Waste Products").

Baptiste Soenen - b.soenen@arvalis.fr

ARVALIS - Institut du végétal

March 2019