GLYPHOSATE-INDUCED TRACE ELEMENT DEFICIENCY
What it is and how to Mitigate the Problems

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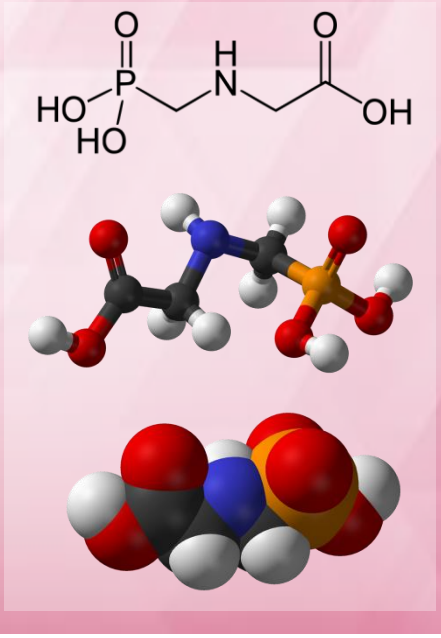
What's in this Insight

This Insight explains the effects of Glyphosate on both crop yield and the soil. It outlines ways and means of mitigating many of the problems associated with its use through good farm practice and management.

Overview



Glyphosate is a non-selective and systemic herbicide introduced in 1971.

Glyphosate has been widely used for many years to clear land prior to sowing. Its use has increased significantly from the early 1990's due to reduced tillage – and more so in recent years due to the development and scale of glyphosate resistant crops (GRC) like soybean, canola, corn and cotton.

Glyphosate persistence in the soil varies widely, and it's half-life could extend over several months.

It is therefore important that the facts surrounding glyphosate and its use are understood and planned, so that crop yields and soil safety are also fully considered.

The Effect of Glyphosate on Crops and Soil

- it inhibits the synthesis of aromatic amino acids, therefore disrupting protein synthesis with the consequence of causing chloroplast degeneration and membrane damage
- it is not metabolised in the plant (i.e. it remains as glyphosate)
- it is translocated in phloem to sinks and metabolically active tissues such as root meristems, and eventually reaches the rhizosphere by exudation
- it reduces trace element availability directly by chemical reactions that reduce availability, and indirectly by suppressing soil micro-organisms that induce nutrient availability
- it has been noted that GRC are more susceptible to trace element deficiency than their related non-transgenic cultivars, (and that this appeared to be partly due to their loss of ability to produce some enzymes and chelates that assist in trace element uptake – a side effect of genetic manipulation)

- its micro-nutrient deficiency is not easily distinguishable and as a consequence contributes to 'hidden yield loss', and further its use complicates both the identification and the solutions
- its micro-nutrient deficiencies increase the incidence of disease and lower crop quality
- its residue in the soil has been known for some time to affect soil biological activities such as earthworm population, nitrogen fixation and respiration

Following such widespread trace element deficiency, researchers simulated glyphosate damage in non-target crops by spraying glyphosate at 1% of the recommended dose. The result was a reduction in uptake, translocation, and tissue concentration of iron, manganese, zinc and copper *('New Phytologist' Vol. 177 pages 899–906, 2008)*. In practice, when glyphosate persists in the soil – with a half life of several months – it is not unrealistic to assume that such small amounts of glyphosate remain active in the soil to damage the non-target crop when taken up by the plant roots.

Some recent analysis of soil, water and vegetables also confirm that glyphosate is present in the plant environment and is taken up by non-target crops *(Teofilo et al 2008)*.

The Effect of Glyphosate on Root Growth and Root Disease

Glyphosate residues reduce root growth, nitrogen fixation and increase the severity of many root fungal diseases. Some of these effects may be attributed to the inhibition of potassium and phosphate uptake, but also to reduction in synthesis of lignin, which is essential for disease resistance.

Glyphosate 'drift-simulation' research provides strong evidence that even at 1% of normal glyphosate rates, it reduces the uptake of trace elements. No doubt, the cumulative effect of glyphosate residues in the rhizosphere and top soil that results from this leakage of glyphosate or breakdown of target crops, is of concern for both trace element availability and for inhibition of ion carriers and integrity of membrane function as well.

Such adverse effects are expected to become more intense and widespread as more glyphosate is used on GRC and minimum-till operations.

Mitigation Measures

Some ways that should be considered towards the mitigation of the effects and losses associated with the use of glyphosate are :

- reducing the number of glyphosate applications
- applying glyphosate at the minimum effective dose
- use of BSN Seed Priming treatment ensuring that a full and balanced load of trace elements penetrate directly into the seed
- spray with Ultra Foliar or a Crop Specific Foliar ensuring that the trace elements are available to the crop with a measured degree of chelation
- possible use of lime or dolomite to release the trace elements that are bound to glyphosate, however it should be noted that this benefit is antagonised by reduced availability of these trace elements due to the fixation and immobilisation of copper, iron and manganese

Conclusion

It is understood and accepted that the effect of glyphosate on both crops and soil is cumulative. Glyphosate is a strong, broad-spectrum nutrient chelator that inhibits plant enzymes responsible for disease resistance so that plants succumb to pathogenic attack.

It is therefore important to pursue ways in which the effects can be countered such as the use of more nutrient efficient varieties and foliar applications of trace elements. These actions will help control nutrient deficiency, assist with disease control and arrest yield losses.

However, the single most effective measure would be treatment with **BSN Seed Primer** prior to sowing, as it increases the concentration of phosphorus and trace elements inside the seed, giving it enormous potential and advantage in lifting yield and countering the glyphosate-effect.

There is an excellent publication on this subject by Emeritus Professor Don M Huber of Purdue University titled 'Ag Chemical and Crop Nutrient Interactions', for your further interest and reference.