WHAT IS GLYPHOSATE?

D. M. R. T. D. K. Divisekara
Board of study in chemical sciences

Glyphosate is a phosphomethyl derivative of the amino acid glycine which is a white and odourless crystalline solid. It was invented in 1950 by a Swiss chemist, Dr. Henri Martin who worked for the small pharmaceutical company called Cilag. But it wasn't use in pharmaceutical applications because the compound had no biological activity in its inorganic division. After that glyphosate was synthesized and tested as a herbicide by Monsanto scientist Dr. Jhon Franze in May 1970. Finally this was introduced as Roundup® herbicide by Monsanto Company [1].

Mode of Action

Glyphosate inhibits the enzyme 5-enolpyrurylshikimate-3-posphate synthase (EPSPS), which present in fungi and bacteria, but not in animals. These enzymes catalyze the transfer of the enolpyruvyl moiety of phosphoenolpyruvate to shikimate-3-phosphate. This is a key step in the synthesis of aromatic amino acid hormones and other critical plant metabolites. The active site of the EPSPS enzyme in higher plants in very highly conserved. The mechanism of inhibition is also unique in that the binding site for glyphosate is reported to closely overlap with binding site of phospho-enolpyruvate [2].

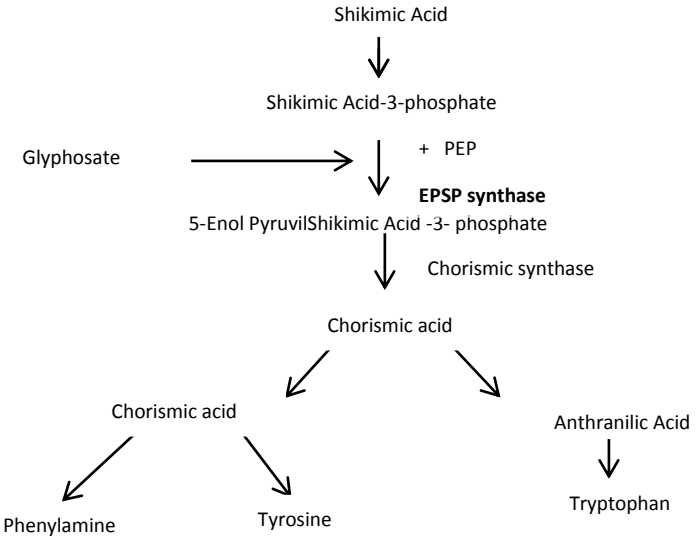

Figure 1: Mode of action of glyphosate [1]

Because of this mode of action glyphosate has become a very effective product. The translocating ability of growing meristematic tissue and inhibit an enzymic process present in plants can be used to control underground corms, rhizomes and other potential vegetative structures. Because of its unique properties, glyphosate was initially used to control perennial weeds on ditch bank in right of way and follow fields. However, utilization for main stream agriculture was limited because the crop was also killed by this chemical. Then the glyphosate is used for land preparation without tilling (non -till practice). Although it kills, it saves fuel, preserves soil from erosion and allows to better water permeation in the soil [1].

Degradation pathway

When glyphosate comes in to contact with soil, it can be rapidly bound to soil particles and become inactive. Unbound glyphosate can be degraded by bacteria. The half-life of glyphosate in soil ranges between 2 and 197 days. Adsorption and desorption of glyphosate depends on the type of the soil properties [3].

Metal chelating effect

Glyphosate has three functional groups (ammine, carboxyl, and phosphate) that can form strong coordination bonds with metal ions to give bidentate and tridentate complexes. These complexes between metal ion and glyphosate have higher affinity than free glyphosate to the adsorbent. Therefore metal ions increase the adsorption of glyphosate on the soil on the other hand the presence of glyphosate decreased the adsorption of metal ion on the soil through changing solution pH and formation complexes of metal and glyphosate which increases the movement of soil water system. This will be potential threat to enhance the quality of the underground water [4, 5].

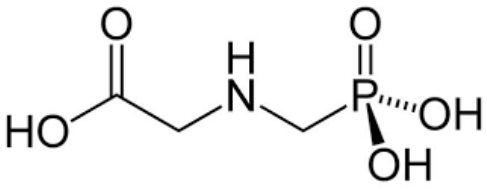

Figure 2: Structure of glyphosate [2]

Toxicity

Glyphosate is the active ingredient in herbicide formulations containing it. However, commercial glyphosate based formulations contain 1% - 41%. They generally consist of an aqueous mixture of the isopropyl ammine (IPA) salt of glyphosate, surfactant and various minor components including anti forming coloring agents inorganic ions to produce pH adjustment. As a result of that human poisoning with herbicide is not with active ingredient alone but with complex and variable mixtures. Therefore, it is difficult to separate the toxicity of glyphosate [1]. Experimental studies suggest that the toxicity of the surfactant, polyoxyethyleneamine(POEA) is greater than the toxicity of glyphosate alone [1].But the residues of glyphosates, found in main foods including sugar, corn, soy and wheat can also give adverse effect to the gut bacteria, which can chronically affect to other mammals also [5].

References

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