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Pre-Harvest Use of Glyphosate & Residues in Food

Introduction

In July 2013, Austria suspended the pre-harvest use of glyphosate as a desiccant pending completion of the on-going EU process for renewal of approval of the active substance[i]. The rationale for that decision has not been published. This decision was characterized as an application of the 'precautionary principle'.

Glyphosate, or *N-(phosphonomethyl) glycine*, the active substance in a range of widely used herbicidal products, has limited toxicity for man, animals and the environment. It is not neurotoxic, carcinogenic or mutagenic, nor is it toxic to reproduction or development. Multiple studies have demonstrated a lack of endocrine disrupting properties.

Authorized pre-harvest uses

Pre-harvest application of glyphosate must be delayed until the grain has a moisture content of 30% or less, when it is physiologically mature and the grain is filled, such that glyphosate cannot be translocated into the grain. Pre-harvest use of glyphosate in cereal and oil-seed crops is authorized in many north-western European countries to:

- control perennial weeds in following crops, especially *Elymus repens* (couch or scutch grass) providing a yield advantage in the following season while improving harvesting efficiency in the current season,
- control late growth of annual weeds, where it occurs, thereby reducing seed return and improving harvesting efficiency
- enhance ripening in cereal and oil-seed crops while reducing crop losses due to pod shatter in oil-seed crops such as oil-seed rape, and
- facilitate harvesting in wet seasons.

Mode of Action of Glyphosate (How it Works)

Glyphosate is not a desiccant. It inhibits the enzyme 5-enolpyruvylshikimate-3-phosphate synthase (EPSP) resulting in reductions in aromatic amino acids that are vital for protein synthesis and plant

growth [ii,iii]. As a consequence, exposed plants display stunted growth, loss of green colouration, leaf wrinkling or malformation and tissue death [3,iv]. Glyphosate is translocated throughout actively growing weed plants, providing high levels of control one year after treatment of *Elymus repens,* other perennial grasses such as *Agrostis* spp, *Holchus lanatus* and *Arrhenatherum elatius* spp. *bulbosum*, perennial dicotyledons such as *Rumex*, *Cirsium* and *Sonchus* spp, and *Convolvulus arvensi* and volunteer potatoes.

Glyphosate is absorbed across the leaves and stems of plants and translocated throughout the plant [2,v] concentrating in meristem tissue [4]. Where treatment is delayed until seed heads or pods are almost ripe (*i.e.* less than 30% moisture), translocation out of exposed leaves or stems does not occur, but the maturation and senescence of green or partly green leaves and stems is more rapid.

Cereal crops ripen determinately *(i.e.* the whole grain head ripens at the same time) but in some varieties, stems remain green even when the grain is ripe. In wet seasons winter cereals can produce secondary tillers with seed heads that ripen much later than the main tillers. In wet harvests the moisture content of grain often remains rather high. Pre-harvest application of glyphosate in all such circumstances hastens maturation and senescence of green tissue, facilitating ease of harvesting in wet harvesting conditions, while improving grain quality.

The lower pods of oil-seed crops ripen before the terminal pods. If left to ripen completely, the lower pods tend to shatter resulting in grain loss. Desiccant herbicides if used ripen the crop but do not reduce pod shatter. Pre-harvest use of glyphosate hastens maturation and senescence of the crop resulting in more even ripening of pods without pod shatter.

Residues in Food and Consumer Risks

Pre-harvest uses of glyphosate do not result in translocation of glyphosate into seed heads or pods. Residual traces do however remain on the surface of seed heads and pods, most of which is removed during processing and preparation for consumption.

Maximum residue levels (MRLs) have been established by the European Commission for glyphosate [vi] and in the case of cereal and oilseed crops are derived on the basis of the residues remaining at harvest following pre-harvest use. MRLs are legal standards established for international trade purposes.

Acceptable Daily Intake (ADI) values are the daily dose that if ingested daily over a lifetime are judged to be without appreciable health risk to consumers. The ADI established by the European Commission for glyphosate is 0.3 mg/kg bw/day. Calculation of consumer intake assuming that all commodities for which use is permitted contained residual traces at the maximum levels permitted, demonstrated that intake could amount to 11% of the ADI [vii]. When the reduction in residue levels that results from processing and correction to reflect monitoring and consumption data, were taken into account, actual intake was shown to amount to no more than 0.6% of the ADI.

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Concluding Observations

The pre-harvest uses of glyphosate for weed control in cereal and oilseed crops and to promote senescence and ripening in such crops are good agricultural practices that reduce crop losses, enhance grain quality and facilitate harvesting in North Western Europe. The residual traces of glyphosate that remain on treated crops and to which consumers may be exposed are minimal being very much less that the acceptable daily intake value for glyphosate established to allow such risks to be quantified.

Please refer to www.glyphosate.eu for further information

i. http://www.parlament.gv.at/PAKT/PR/JAHR_2013/PK0637/

ii. Tomlin, C. D. S. The Pesticide Manual: A World Compendium, 14th ed.; British Crop Protection Council: Hampshire, UK, 2006; pp 545-548.

iii. Herbicide Handbook, 8th ed.; Vencill, W. K. Ed.; Weed Science Society of America: Lawrence, KS, 2002; p 231-234

iv. Franz, J. E.; Mao, M. K.; Sikorski, J. A. Glyphosate: A Unique Global Herbicide; American Chemical Society: Washington, DC, 1997; pp 521-527, 604-605, 615

v. Roberts, T. R. Metabolic Pathways of Agrochemicals-Part 1: Herbicides and Plant Growth Regulators; The Royal Society of Chemistry: Cambridge, UK, 1998; pp 396-399

vi. Commission Regulation (EU) No 293/2013 of 20 March 2013 amending Annexes II and III to Regulation (EC) No 396/2005 of the European Parliament and of the Council as regards maximum residue levels form emamectin, benzoate, etofenprox, etoxazole, flutriafol, glyphosate, phosmet, pyraclostrobin, spinosad and spirotetramet in or on certain products OJ No L96 5.4.2013 p1

vii. Harris CA and CP Gaston, 2004, Effects of refining predicted chronic dietary intakes of pesticide residues: a case study using glyphosate, Food Additives and Contaminants, Vol 21, No 9 (September 20014) pp 857-864