Friends of the Earth Europe

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Problems with glyphosate overuse and alternatives for farmers

Friends of the Earth Europe, June, 2013

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Introduction

Glyphosate is the world's bestselling chemical herbicide. Glyphosate-containing herbicides, such as Monsanto's Roundup, are the most widely used herbicides in Europe and are applied in farming, forestry, parks, public spaces and gardens. Glyphosate-containing herbicides are also crucial to the production of genetically modified herbicide resistant crops. In recent years a number of scientific studies have raised concerns about glyphosate's safety and there have been calls for glyphosate-containing herbicides to be banned. New research by Friends of the Earth has detected glyphosate residues in the urine of 44 percent of people tested, from 18 different European countries.

The use of glyphosate in EU agriculture

Glyphosate accounts for around 25% of the global herbicide market[i]. The European Union does not publish data on the use of individual pesticides, making it difficult to find out how much glyphosate is being used by farmers in EU countries. But data from individual countries indicates how reliant EU farmers have become on glyphosate. For example glyphosate is the top ranked herbicide in UK arable crop production[ii]. It accounts for 35% of all pesticides used in agricultural production in Denmark[iii], and it has been estimated that glyphosate is applied to 39% of agricultural land in Germany[iv]. Between 50% and 60% of sunflower crops in France, Romania and Hungary are treated before harvest with glyphosate[v].

Glyphosate cannot be used to directly control weeds in a growing crop, unless the crop has been genetically modified to resist glyphosate. This is because it would kill the crop plants as well as the weeds. But glyphosate is still heavily used in the production of non-GM crops in Europe, and has approvals for a wide range of uses in cereals, oilseed rape, field beans, sunflowers, maize, sugar beet, orchard crops, olive groves, vines and grassland. In some countries it is sprayed onto cereals and oilseed crops around two weeks of harvest, a practice known as desiccation.

The following table is taken from a Monsanto submission to the European Union. It shows the very wide range of approvals that pesticide companies have achieved for glyphosate.

Box I: Approved uses in selected countries[vi]:

Usage situation by country	Belarus	Belgium and Luxemburg	Bulgaria	Czech Republic	Denmark	Finland	France	Germany	Greece	Hungary	Ireland	Italy	Kazakhstan	Netherland	Norway	Poland	Portugal	Romania	Russia	Slovakia	Spain	Sweden	Switzerland	Turkey	UK	Ukraine
Pre-plant	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y
Pre-emergence / Post plant	Y	Y	Y		Y	Y		Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y			Y	Y		Y	Y
Pre-Harvest (cereals / other crops)	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y		Y	Y	Y	Y		Y	Y	Y		Y			Y	Y
Harvest aid / Desiccation	Y	Y	Y	Y	Y			Y		Y	Y		Y	Y	Y	Y		Y	Y		Y	Y			Y	Y
Post-Harvest / Stubble	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y
Vines / Orchards / Olives	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Grassland renewal	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y
Set-aside		Y				Y	Y	Y		Y	Y	Y		Y		Y	Y	Y			Y	Y	Y	Y	Y	
Forestry / Christmas tree	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	
Crop inter-row		Y				Y	Y	Y	Y			Y		Y			Y	Y			Y		Y			
Railway / Amenity / Non crop use	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Aquatic use / Water ditches	Y			Y					Y		Y		Y						Y	Y	Y				Y	

Glyphosate as a desiccant

As can be seen from Box 1, glyphosate is approved as a desiccant in many EU countries. Desiccation is the practice of spraying plants with herbicides a short time (one to two weeks) before harvest, and can be common in countries where summers can be wet, such as the UK and Germany. Glyphosate is sprayed onto nearly-ripe crops and this causes the plants to concentrate their energy into producing seeds, while the rest of the plant dies more quickly. This can reduce the moisture content of harvested grains, as well as killing any late weeds, and so may allow an earlier harvest.

The use of glyphosate as a desiccant varies greatly between countries. In the UK, for example, glyphosate is used on 78% of oilseed rape as a harvest aid, while in Germany only 4% of the arable acreage is managed with glyphosate as desiccant (mostly on winter barley and grain legumes) constituting in 11,2% of the glyphosate use[vii]. Desiccation is also used on sunflower and grain maize crops. According to information from the pesticides industry,

between 50% and 60% of European sunflowers, mainly grown in France, Romania and Hungary, are treated with glyphosate as a desiccant. [viii]

Glyphosate applied in this way remains largely unchanged, and is transported throughout the plant into the leaves, grains or fruit[ix]. Applying the herbicide close to harvest means that it is more likely to be present in the resulting foods. For example, the increased use of glyphosate as a desiccant on UK wheat crops has been linked to increased glyphosate residues in UK bread[x].

The EU sets legal 'maximum residue levels' (MRLs) for the amount of pesticide residues allowed to be present in foodstuffs. The limits are measured in milligrams of pesticide per kilogram of food (mg/kg). In the case of glyphosate, permitted amounts are highest for crops on which it is used as a desiccant. For example, the MRL for glyphosate in fresh beans and peas is 0.1mg/kg, but for dried peas and beans the MRL is 100 times higher, at 10 mg/kg[xi]. This difference is because glyphosate is used as a desiccant during the production of dried peas and beans, but not when they are sold green. The MRLs for other crops that might be subject to desiccation using glyphosate are also high. For example, the glyphosate residue maximum in wheat and oilseed rape is 10mg/kg. For oats, barley and sunflower seeds it is 20 mg/kg. Recently, the MRL for glyphosate in dried lentils was increased by 50 times in order to "accommodate the authorized desiccation use of glyphosate on lentils in the United States and Canada" raising it up to 10 mg/kg.[xii]

While this use of glyphosate has been promoted to farmers, its advantages may be less than suggested. A detailed study in the UK examined the use of glyphosate as a desiccant in cereal crops[xiii]. One of the reasons for using glyphosate is to reduce the moisture content of the harvested grain. But the UK study found that the application of glyphosate to weed-free and evenly-maturing cereal crops provided little or no advantage in terms of moisture content. And if glyphosate is applied when the grain is too green, it can actually reduce yield.

Farmers have to consider that the use of glyphosate as a desiccant prevents them from saving seed from the crop to use the following year, because the germination capacity is reduced[xiv]. They can't also use treated straw as a horticultural growth medium or as a mulch.[xv] Further problems are observed with spray drift affecting seed potatoes and hedgerows when spraying tall crops.[xvi]

The DLG (Deutsche Landwirtschafts-Gesellschaft e.V.), a German association from the agricultural and food industry , has called for caution in the overall use of glyphosate and specifically questioning its use as a desiccant in order to avoid losing its effects in other instances where farmers may have fewer alternatives.[xvii]

Weed resistance

One of the concerns for farmers about the widespread use of glyphosate is that weeds will develop resistance to it. Resistant weeds are more likely to develop when the herbicide is sprayed more often, continuously and in bigger quantities[xviii].

The first case of a weed species (*Lolium rigidum*) with naturally evolved resistance to glyphosate was recorded in the 1990s, 20 years after glyphosate was first introduced[xix]. Today, more than 24 weed species are resistant to glyphosate. 19 of these species are found in the USA and South America, following the introduction of genetically modified glyphosate resistant crops. According to the Weed Science Society of America, glyphosate resistant weeds have been found on more than 5.7 million hectares of US farmland[xx], and in 2012 49% of US farmers reported having glyphosate resistant weeds on their farms[xxi].

In EU countries, and even without the introduction of herbicide resistant crops, there are already 12 cases concerning 5 glyphosate resistant weed species.[xxii] Resistant *Conyza bonariensis* (hairy fleabane) was recorded in orchards in Spain, in 2004[xxiii]. Now all five glyphosate resistant weed species were recorded in Spain and two of them in Italy, with single resistant species recorded in the Czech Republic, France, Greece, Poland, and Portugal.[xxiv] Most of the documented cases arise from vineyards and orchards[xxv], where common practice has been to apply glyphosate two or even three times a year[xxvi]. However, populations of glyphosate resistant grass (*Lolium spp*) have also been identified from arable fields in Italy[xxvii].

Given that glyphosate resistance is already developing, the wide range of approvals across the EU suggests a lack of caution on the part of regulators. The more widely glyphosate is used, the more likely it is that further species will develop resistance.

Increasing costs of weed control

The experience from GM crop production in the USA and South America shows that the development of weeds resistant to glyphosate has significantly increased costs for farmers. There has been a more than 15-fold increase in the use of glyphosate by US farmers between 1994 and 2009[xxviii], as well as an additional 25 million litres of other herbicides being used. It is estimated that weed resistance has led to production cost increases in the USA of between $160 – 950 million per year[xxix]. A survey of US farmers found that more than one third of those growing GM glyphosate resistant crops were planning to use other herbicides in the 2012 growing season, in order to tackle glyphosate resistant weeds[xxx]. In some areas of the southern United States, farmers are resorting to weeding by hand and glyphosate is viewed as redundant[xxxi]. In Argentina, the expansion of glyphosate resistant Johnson grass is increasing weed control costs by hundreds of millions of dollars only in few years[xxxii].

The increasing costs of glyphosate resistance is not just a future problem for farmer outside the EU. As mentioned, glyphosate resistant weeds already occur in European farming systems, particularly in Mediterranean countries. Additional herbicides are being investigated to control glyphosate resistant weeds in orchards and vineyards in Greece[xxxiii], Portugal[xxxiv], Spain and Italy[xxxv] and therefore increasing the costs for the farmers. Recent research suggests that glyphosate resistant weeds may also be more disease resistant, due to interactions with micro-organisms in the soil. According to researchers "*We may be selecting not only for glyphosate resistance, but inadvertently selecting for weeds that have disease resistance as well*" adding up to the expenses of farmers[xxxvi]

Effects on crops

Recent studies show increased problems with diseases in crops where high doses of glyphosate have been applied. Fusarium fungal infections of crops treated with glyphosate were being recorded in the early 2000s. This was not only found in GM soya, but also in non-GM wheat and barley where glyphosate was used to control weeds prior to the crop being sown. Infection risks can be two to five times higher than in untreated crops[xxxvii]. Similarly, a Canadian study found an association between the previous use of glyphosate in a field and infections of following wheat crops with *fusarium* fungal diseases[xxxviii]. It has also been suggested that the use of glyphosate to control weeds before sowing cereal crops may

contribute to outbreaks of the problematic disease 'take-all' (*Gaeumannomyces graminis*)[xxxix].

Micronutrients are essential for healthy plants because they play a vital role in many biochemical processes within plants. It has been suggested that glyphosate can interfere with the uptake of minerals such as manganese by plants, with potential impacts on health and productivity of the crop[xl] [xli]. It is also suggested that glyphosate interferes with the uptake of other essential minerals, such as copper and zinc, in GM glyphosate resistant soybeans [xlii] [xliii].

Effects on animals

Livestock production in the EU is already heavily intensified. In poultry and pig production, animals are mainly fed with concentrated feed, and zero- grazing systems are common.[xliv] In dairy and beef production, the trend is also to move away from grazing, with less fodder being produced on the farm and increases in the use of soya and corn based feeds.[xlv] More than 90% of the soya imported to EU is used for animal feed[xlvi], and a big part of it is genetically modified. Two of the biggest suppliers of soya are Argentina and Brazil. In these countries 100% and 70% of the soya acreage is planted with GM soya, and high doses of glyphosate are used. The MRL for glyphosate residues in soybeans is 20 mg/kg[xlvii], but there is no EU testing of glyphosate residues in soybean imports. The likelihood that there is "a significant livestock exposure to glyphosate and its metabolites" has been recognised by the European Food Safety Authority[xlviii].

Studies from the Leipzig University in Germany found that glyphosate negatively impacted gastrointestinal bacteria from poultry, when these were grown in vitro. The research also found that pathogenic bacteria (*Salmonella Entritidis, Salmonella Gallinarum, Salmonella Typhimurium, Clostridium perfringens and Clostridium botulinum*) are highly resistant to glyphosate, whereas most beneficial bacteria (*Enterococcus faecalis, Enterococcus faecium, Bacillus badius, Bifidobacterium adolescentis* and *Lactobacillus* spp) were moderately to highly susceptible to it[xlix].

In cattle, an increase of diseases associated with the bacterium *Clostridium botulinum* has been observed in the last 10-15 years in Germany. *C. botulinum* can be responsible for

serious food poisoning, referred to as botulism. Although the reason for the increased *C. botulinum* associated diseases is not fully known, ingestion of glyphosate has been suggested as a significant predisposing factor[l].

Is weed control really impossible without glyphosate?

Glyphosate has been approved for a wide range of weed control uses in EU agriculture, and it appears that farmers have become heavily dependent on this one chemical. It has been claimed that "*food prices would increase and the EU's share of the global agricultural market would decrease if glyphosate use was restricted*"[li], and that the use of other pesticides would increase, as well as costs to farmers[lii]. But effective non-chemical weed control practices do exist. In organic farming, weed control is done without any herbicides. The aim is to maintain weed populations at manageable levels, recognising the value of weeds in providing food and habitats for a range of beneficial organisms [liii]. Some of the practices used by organic farmers include crop rotation, choice of crop species and varieties, as well as the use of stale and false seedbeds, under sowing in cereals and inter-cropping.[liv]

Integrated weed management, which is used by non-organic farmers, takes a similar approach. Although herbicides are not ruled out, a range of other techniques are applied to greatly reduce reliance on them. These include tillage, delayed sowing, crop rotation, mowing, mulching and biological methods. Such methods average at around 80% effectiveness in controlling weeds, although this can vary[lv]. The aim is to reduce weed populations across the whole farm, and prevent problems arising in the first place. Integrated weed management requires more knowledge and decision-making by farmers. Under the terms of EU Directive 2009/128 on the sustainable use of pesticides, national governments will be required from 2014 to promote integrated pest and weed management to farmers, "*giving wherever possible priority to non-chemical methods*"[lvi].

Box II: Non-chemical weed control techniques[lvii]

Crop rotation	Crop rotation with grass breaks give the best results. Clover breaks, and crops in which weeds are easy to manage, are important for stockless rotations.
Choice of crop variety	Cereal and pea varieties vary in their ability to shade out weeds. Amongst cereals, triticale and oats are more competitive than wheat or barley.
Use of stale seed beds	Preparing the seedbed several weeks before sowing in order to stimulate a flush of weeds and therefore reducing the weed seed bank likely to affect the crop. The small weeds can then be removed with a very shallow harrow, or with a flame-weeder or infra-red burner.
Mixed cropping and under sowing	Mixed cropping of cereals and pulses are also more competitive than each crop alone. Inter-sowing or under sowing crops gives good suppression of annual weeds. Early sowing in autumn increases weed pressures.
Use of allelopathy (plant species producing chemicals that affect the development of plants growing in their immediate environment)	The use of rye, cut and left, prior to sowing soybean has been used in the USA and in Germany.[lviii lix] Sunflower residue can inhibit weed growth, but also wheat growth in minimum-till situations.

Conclusions and demands

New research from Friends of the Earth has shown that people from all over Europe – in EU and none EU countries – have glyphosate residues in their urine. The evidence suggests that a significant proportion of the population could have glyphosate in their bodies – and it is not clear where it is coming from. Despite the fact that glyphosate is the world´s best-selling chemical herbicide and glyphosate-containing herbicides are the most widely-used herbicides in Europe, very little testing is done for glyphosate residues in food, feed, or water. Tests for glyphosate in the body do not take place at all.

Friends of the Earth wants to know:

- Why do people have glyphosate in their urine? Where does it come from?
- Why haven´t public authorities done any testing on glyphosate residues in humans?
- Why is food, animal feeds (such as imported soy) and drinking water so rarely tested for glyphosate?
- What are the health impacts of glyphosate in our bodies? Is it guaranteed that glyphosate residues are completely excreted? If not, what happens to the remaining residues?
- Why haven´t there been any long-term health studies on on-going glyphosate uptake in humans?
- Why have the maximum residue levels (MRLs) for glyphosate in food and feed been steadily increased?
- Who is profiting from increasing glyphosate use?
- Why are authorities considering applications to grow glyphosate-resistant genetically modified crops in Europe?

Given the uncertainty about how glyphosate is entering people and the need to minimise exposure to glyphosate, Friends of the Earth demands that:

- The EU and national governments must immediately start a monitoring programme for glyphosate in food and feed, including imported animal feed crops such as GM soy. Levels of glyphosate (and its breakdown product AMPA) in the environment should also be monitored, covering aquatic systems and soil. These monitoring programmes

should be comprehensive and the results should be made available to the public without delay.

- National governments must introduce a glyphosate reduction programme and desiccation (spraying crops shortly before the harvest) should be banned without delay. All other uses for glyphosate should be evaluated by 2015, existing maximum residue limits (MRLs) should be re-evaluated, and there must be no further increases in the MRLs.
- No glyphosate resistant genetically modified crops should be authorized in the EU.
- All food processors and retailers should minimise their customer´s exposure to glyphosate residues by specifying glyphosate-free products from their suppliers. They should extend their internal pesticides monitoring programme and include glyphosate in their regular testing.

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