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GLYPHOSATE USAGE – PROS, CONS AND ALTERNATIVES

Glyphosate is the most commonly used herbicide globally. Its use has been linked to cancer, environmental damage and antibiotic resistance. This article examines why there is confusion about its safety, and the research that supports glyphosate as a more effective and safer option than the available alternatives.

Call for ban

People are right to be wary about chemicals – but fear of synthetic chemicals (termed 'chemophobia') is increasing and taking hold of people's understanding, or rather misunderstanding. The fear is increasing despite the fact that the chemical companies spend a considerable amount of money on research and development, releasing chemicals only after rigorous testing both for health impacts and target effectiveness. No user or consumer wants to be exposed to anything that might lead to health problems and chemical companies do not wish to end up in court.

The chemical industry has been estimated to spend over $300 million per product on research and development before a chemical is released (https://croplife.org/wp-content/uploads/2016/04/Cost-of-CP-report-FINAL.pdf). Human health is at the forefront of concerns, and environmental protection authorities and agencies around the world are focused on ensuring protective guidelines to reduce the risk to operators.

Glyphosate (commonly sold as Roundup) has been at the centre of many debates, in part because of increased use. It is now the most commonly used herbicide globally. It is also frequently associated with the advent of genetically modified (GM) crops. It is used as a herbicide, both in New Zealand and globally, in many situations and not just for GM crops. Concerns over its use has led many, most notably the Green Party, to call for a ban.

Californian court case

Fears were heightened in August last year by the Californian ruling on glyphosate which implicated a groundsman's non-Hodgkins lymphoma diagnosis to his use of the chemical. The jury decided that glyphosate was a plausible contributing factor and the plaintiff did not have to prove that the chemical did cause the cancer. Monsanto was ordered to pay the equivalent of over NZ$400 million. Monsanto appealed the verdict.

In October 2018 a Superior Court Judge, Suzanne Bolanos, partially overturned the verdict. Judge Bolanos let stand the jury's finding that Roundup caused Johnson's cancer, but decided that the punitive damage award of $367 million was too high and offered a choice – accept $57 million in punitive damages or submit to a new trial on the punitive damages. The compensatory damages of $57 million would remain intact either way (see http://theconversation.com/roundup-weed-killer-lawsuit-hits-a-snag-but-monsanto-is-not-off-the-hook-105559).

Chemical spills into waterways have been associated with aquatic organism deaths. When glyphosate is used as recommended, which includes avoidance of waterways, no effects have been recorded.

This ruling clearly did not absolve either Monsanto or glyphosate of blame and arguments about banning its use continue globally. Despite headlines suggesting an increasing number of countries are becoming glyphosate-free, the reality appears to be different and involves restrictions and/or investigating alternatives in specific areas (see www.baumhedlundlaw.com/toxic-tort-law/monsanto-roundup-lawsuit/where-is-glyphosate-banned/), as well as more frequent re-assessments of approval (e.g. in Europe).

Opposing views caused by different terms of reference

In 2015, two reports from credible organisations were released. One categorised glyphosate as a 'probable human carcinogen' and the other stated that 'on the available scientific evidence, there are no grounds to classify the controversial herbicide, glyphosate, as a carcinogen, as a mutagen or as toxic for reproduction.'

The difference in the outcome reflects the difference in the terms of reference for the organisations. The first glyphosate report was by the independent International Agency for Research on Cancer (IARC) and involved 17 experts who reviewed all published peer-reviewed literature. IARC identifies hazards and does not take into account the likelihood of exposure to the substance, so it does not address the risk of exposure. IARC's list of known carcinogens (Category 1) includes alcoholic beverages, tobacco, solar radiation and wood dust. The probable carcinogens (Category 2A) include shift work, processed meat, frying and red meat, as well as glyphosate.

The second report concluding that glyphosate was safe to use, as long as guidelines on use were followed, was from the European Chemicals Agency (ECHA) Committee for Risk Assessment. ECHA's investigation involved an extensive evaluation of all the information available, including human evidence and 'the weight of the evidence' of animal studies.

Since the reports were released considerable mud-slinging has occurred, including suggestions that contributors to the IARC report were conflicted and that significant evidence was ignored. Hence the debates about use continue.

Evidence for human effects

All chemicals have the potential to cause harm if ingested at high enough doses. The American Cancer Society has explained that:

> ***... carcinogens do not cause cancer at all times, under all circumstances. Some may only be carcinogenic if a person ingests it, for example, as opposed to touching it; some may cause cancer only in people with a certain genetic makeup; some agents may lead to cancer after only a very small exposure, while others might require intense exposure over many years.***

The ongoing concern about sugar is a case in point. Sugar is not toxic, but eaten in large quantities can lead to obesity and other negative consequences. Obesity was reported to be responsible for 3.9% of cancers worldwide last year.

Alcohol (IARC Category 1) causes 3.6% of all cancers and 3.5% of cancer-related deaths. In contrast, studies of agricultural workers and their families in America published at the end of 2017 in the *Journal of the National Cancer Institute* found that, 'glyphosate was not statistically significantly associated with cancer at any site.' The research involved almost 55,000 people, 83% of whom used glyphosate.

The authors noted an increased, but not statistically significant, risk of acute myeloid leukaemia (AML) in the highest exposure quartile compared with 'never users'. AML can arise during non-Hodgkin's lymphoma treatment. Note that the study could not assess whether the 55,000 people studied did or did not follow the guidelines for use designed to minimise risk. Following the Californian court case, Dr Andrew Kniss, Professor of Weed Science at the University of Wyoming, calculated that 97% of people with non-Hodgkin's lymphoma have had no exposure to glyphosate.

Also following the case, the Environmental Working Group (EWG) released a non-peer reviewed study claiming that parents were serving their children breakfast with a 'dose of the weed-killing poison.' This story was circulated widely in the media and increased public fear. American experts examined the report and concluded that, 'A bowl of cheerios, or a daily bowl over months or even many years, won't endanger your health. Why? Because we are talking about minuscule amounts of glyphosate – well below the levels that would be considered dangerous.'

Other concerns

Soil and water organisms

Some reports exist of decreases in soil organism activity after glyphosate application. Given a reduction in food source because of the death of plants, this is not surprising. It is also to be expected that the soil organism

profile will change with repeated use of glyphosate because use tends to be associated with specific crops and crop rotations. Chemical spills into waterways have been associated with aquatic organism deaths. When glyphosate is used as recommended, which includes avoidance of waterways, no effects have been recorded.

Antibiotic resistance

Research on antibiotic resistance at the University of Canterbury has implicated glyphosate, but medical scientists have another theory centering around increased antibiotic use in humans.

A review produced by the Ministry of Health and the Ministry for Primary Industries in 2017 pointed out that, 'New Zealand communities have increased their consumption of antimicrobials by as much as 49% between 2006 and 2014.' The review also showed that the level of consumption in New Zealand is high in comparison with many other European countries. New Zealanders average approximately 26 defined daily doses per day, in comparison with 21 for the UK, 16 for Germany and 11 for The Netherlands.

Antibiotic resistance in New Zealand is relatively low, but is emerging and spreading. Research identifies several reasons, the first being inappropriate use of antimicrobials, which includes overuse of broad spectrum antibiotics such as topical antibiotics.

Transmission of resistant organisms in both community and health care settings is also a factor, as is the importation of resistant pathogens from areas where multi-drug-resistant organisms are endemic. In various countries, including some in the Asian sub-continent, antibiotic drugs are available without prescription.

A fourth issue identified is environmental and genetic factors that increase the viability of multi-drug-resistant bacteria. Professor Heinemann (University of Canterbury) has been writing about this possibility for some time, citing the use of antibiotics in animals and chemical use in the environment as factors. New Zealand has the third lowest use of animal antibiotics in the OECD.

The Ministry of Health and the Ministry for Primary Industries review suggests that this reflects the strong regulatory controls on the use of antimicrobial agents, which limit prescribing and dispensing to the veterinary profession. It also says that, 'animal husbandry systems are relatively low in intensity.' A further factor is ongoing government and industry investment in initiatives to limit antimicrobial resistance.

Glyphosate and benefits of no-till farming

Glyphosate acts through the plant system and the effect lasts for several months. Glyphosate is used in cropping as part of seed bed preparation and is particularly important as a replacement for traditional ploughing, which buries many emerging weeds. No-till farming reduces tractor time and hence fossil fuel consumption, as well as soil compaction. Without cultivation the soil organic matter – and all the soil organisms within it – are maintained and the potential for soil loss through erosion is reduced.

In the US the adoption of minimum-tillage and no-till cropping resulted in a 43% reduction in soil erosion between 1982 and 2003. Further, crop residue in no-till farming increases water infiltration into, and reduces evaporation from, the soil. This means there is less run-off of water and a reduced potential to lose fertilisers and pesticides in run-off water. No-till is considered an integral component of sustainable intensification (see https://geneticliteracyproject.org/2018/12/20/can-we-meet-a-growing-need-for-food-without-destroying-our-environment/?mc_cid=fdb79b9fb1&mc_eid=5165fc44e1).

Alternatives to glyphosate

Alternatives to glyphosate are available but questions remain about safety, effectiveness and cost.

Vinegar (acetic acid) and other acids and oils

Vinegar has been promoted in the New Zealand media. Like lemon juice (citric acid), at sufficient concentration it burns leaf cells and destroys the tops of plants. Boiling water, steam, or flames will do the same. However, the roots will often survive and in some plants that means regeneration of leaves will occur.

In response to ratepayer concerns about the use of glyphosate, Bristol Council in the UK spent a year comparing various ways of controlling weeds. The Council report states, 'For acetic acid and hand weeding the weeds started re-emerging within a month. On comparison sites treated with glyphosate, the weediness scores stayed low for five to six months.'

Researchers calculated that it would cost at least three times as much to spray the city with vinegar on a monthly basis than use glyphosate, and concluded that this cost would be financially 'prohibitive'. Further concerns included corrosion in the equipment due to the acidic nature of vinegar and a much greater requirement in terms of protective clothing for the operators than that required for glyphosate.

Pelargonic acid (a chemical found in several plants and therefore considered 'natural' like vinegar and lemon juice) gave immediate or short-term suppression of growth of vegetation, as did clove oil in a study in Massachusetts. The suppression lasted for three to six weeks after which growth was not distinguishable from untreated vegetation. Again, a requirement for repeated applications was noted.

The research also reported that formulations of citric-acetic acid or a citrus-derived product (limonene) gave no control or only weak suppression of vegetative growth soon after application, and no suppression was evident after three to six weeks. A similar suppression time was noted for steam, hot water and torching.

Paraquat

Paraquat is effective and does have uses in agriculture (e.g. in lucerne production or in rotation with glyphosate), but it is highly toxic. The lethal ingestion dose of paraquat in humans is 35 mg/kg. No lethal ingestion dose has been reported for glyphosate, although there are warnings about immediate treatment if splashed in the eye.

Consequences of a ban

Glyphosate is integral to the use of GM crops grown overseas and in many cases they have been modified to allow its use. In general, GM crops outyield their conventional counterparts. Last year a comprehensive review examined 6,000 studies published over two decades and concluded that, 'GMO corn increased yields up to 25% and dramatically decreased dangerous food contaminants.' In primary production, whether GM or not, banning glyphosate would reduce food availability and hence increase prices.

A report for the UK Crop Protection Association by Oxford Economics researchers forecast a reduction in area of 20% for wheat grown and 37% for oilseed rape (canola) if glyphosate was banned. Further, yields on the reduced area were forecast to decrease – 12% for wheat and 14% for oilseed rape. Labour productivity would decrease by 10% and earnings before interest, tax, depreciation and amortisation (EBITDA) would reduce by 13.9%. This in a country where the Department of Environment, Food and Rural Affairs indicates that only 25% of farms actually make money from farming (see https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/683972/future-farming-environment-).

A report from Germany has suggested that, 'where the cultivation of certain crops is no longer profitable, their production would either need to be subsidised, or farmers would need to switch to the cultivation of other crops.'

In New Zealand the impact could be considerable, both for costs to the farmer, which would not be cushioned by subsidies as they might be (as indicated by the German report) in the Northern Hemisphere, and prices to the consumer. Increasing costs could put farmers out of business unless the costs could be passed to the consumer. However, increasing prices could render New Zealand produce uncompetitive on the global market – and so the economy would be at risk.

There could also be a negative impact on the environment. The impact would be on soil quality as no-till cultivation practices would not be possible, alongside increased greenhouse gas (GHG) emissions due to increased fossil fuel, and increased chemical requirements sometimes requiring several passes across a paddock (hence increasing GHGs still more), and also increasing soil compaction which then requires more cultivation post-crop.

Loss of competitiveness in food production and the potential to affect global food prices were highlighted in the European reports because of the knock-on effects for the economy. For New Zealand, with the bulk of food exported, competitiveness is important. However, so is minimising erosion and GHG production while maximising soil quality, including organic matter.

Conclusion

All chemicals should be handled with care at all times, and 'care' means reading the instructions. It is possible to produce food without using glyphosate – organic producers manage. Their food does, however, tend to be more expensive than that produced conventionally.

The question of whether consumers will be prepared to pay the price for glyphosate-free production, and accept that there will also be both positive and negative environmental implications, remains. An alternative is that they accept the European Chemicals Agency ruling that the available scientific evidence did not meet the criteria to classify glyphosate as a carcinogen, as a mutagen or as toxic for reproduction. In combination with the results from the US research on 55,000 agricultural workers, consumers should feel reassured that the chemicals approved for use are safe when used as directed.

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